AVIATION WEEK

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May 20, 1957 50 Cents

Design Manual: Charts Aid Quick Aircraft Estimate

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Up where the cost of failure is too high—where the low ambient pressure causes your fuel to boil and vaporize—for maximum confidence, the answer is HY-v/l Fuel Pumps.

Higher ceilings and faster rates of climb have accentuated the problem of boiling fuel vapor that locks the fuel supply and causes engine failure.

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- No Vapor Separator. The pump recondenses the vapor back into liquid.
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- Simplicity of design. Minimum number of parts. Easy to service.
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- Recent 1200-hour "Dry Run" torture test proves maximum reliability. Needs no thermal protection device or switch.
- Has "Design Predictability", i.e., it can easily be tailored to your specific needs.

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World's Fastest Navy Fighter

9 Proudly wears Sargent controls

Nine Sargent quality units have been selected to provide Chance Vought's F8U-1 Crusader with instantaneous, positive, feathertouch response.

These units, Sargent fabricated to Vought specifications, provide a system for control for the safe, positive, efficient operation of this great fighter.

The experience of more than 36 years of design and manufacture of precision equipment systems has given Sargent Engineering Corporation the "know-how" to aid in solving the essential and advance problems of force control. Leading airframe and missile manufacturers are using hundreds of different Sargent hydraulic, mechanical, pneumatic, electrical and electronic force control units on the nation's military planes, commercial planes and missiles.

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AVIATION CALENDAR

May 20-22—1957 Design Engineering Conference American Society of Mechanical Engineers, Coliseum, New York.

May 23—Gunter Loeser Memorial Lecture, Progress and Prospects of Radar Meteorology, Dr. David Atlas, Charter Rm., New England Mutual Bldg., Boston, Mass.

May 24-June 2—22nd Paris Air Show, Society of French Aircraft Constructors, LeBourget Airport, Paris.

May 27-29—National Telemetering Conference, Hotel Cortez, El Paso, Tex.

May 28-29—Annual Business Aircraft Safety Seminar, sponsored by Flight Safety Foundation, Park Sheraton Hotel, New York.

May 30-June 2—Wright Memorial Glider Meet, sponsored by Soaring Society of Dayton, Cox Municipal Airport, Dayton.

June 1—8th Annual Maintenance and Operations Meeting for Business and Executive Aircraft Owners, sponsored by Reading Aviation Service, Reading Municipal Airport, Pa.

June 3-5—First General Aviation Law-Science Seminar, Wichita University, Kans.

June 4-5—1957 Biennial Electronic Materials Symposium, University of Pennsylvania, Philadelphia, sponsored by Institute of Radio Engineers and University of Pennsylvania.

June 6-7—National Symposium on (Electronic) Production Techniques, Willard Hotel, Washington, D. C.

June 8-12—Technical Personnel Recruiting Exposition, in conjunction with National Technical Career Conference, Sherman Hotel, Chicago, Ill.

June 9-14—Semi-Annual Meeting, American Society of Mechanical Engineers, Sheraton Palace Hotel, San Francisco, Calif.

June 10-14—Lecture Series on Vacuum Metallurgy, sponsored by New York University College of Engineering. Address inquiries to: Dr. R. F. Bunshah, N. Y. University College of Engineering, University Heights 53, N. Y.

(Continued on page 6)

AVIATION WEEK • MAY 20, 1957

Vol. 66, No. 20

Published weekly with an additional issue in December by the McGraw-Hill Publishing Company, James H. McGraw (1860-1948), Founder. Executive, Editorial, Advertising and Subscription offices: **McGraw-Hill Building, 330 West 42nd Street, New York 36, N. Y.** Publication Offices, 99-129 North Broadway, Albany 1, N. Y. Donald C. McGraw, President; Joseph A. Gerardi, Executive Vice President and Treasurer; Hugh J. Kelly, Executive Vice President; John J. Cooke, Secretary; Nelson Bond, Executive Vice President, Publication Division; Ralph B. Smith, Vice President and Editorial Director; Joseph H. Allen, Vice President and Director of Advertising Sales; A. R. Venezian, Vice President and Circulation Coordinator.

Subscriptions are solicited only from persons who have a commercial or professional interest in aviation. Position and company connection must be indicated on subscription orders.

Single Copies 50¢. Subscription rates—United States and possessions, $6 a year. Canada $8 a year.

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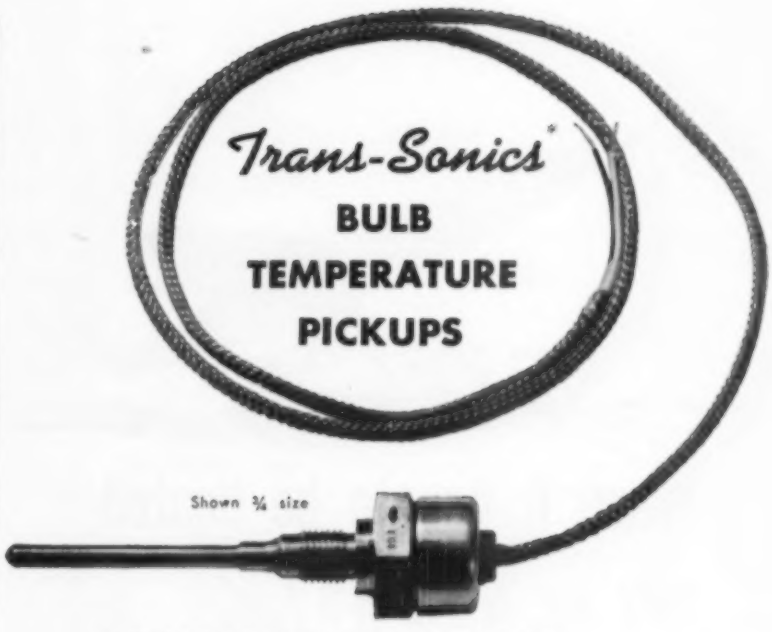
BULB TEMPERATURE PICKUPS



- **OUTPUT UP TO 5 VOLTS WITHOUT AMPLIFICATION**
- **ACCURATE UNDER 25G TO 2,000 CPS VIBRATION**
- **AVAILABLE IN VARIOUS RANGES FROM —300°F. TO 1500°F.**
- **RESISTANCE CHANGE OF 100 OHMS OVER SPECIFIED RANGE**

Trans-Sonics Type 1300 Bulb Temperature Pickups are precision high-speed resistance thermometers with a platinum resistance winding as the sensing element. Each Type 1300 Bulb Temperature Pickup is individually calibrated and supplied with its own calibration sheet. The temperature interval over which the 100 ohm resistance change will occur may be as low as 100°F. These Pickups are designed to withstand pressures up to 3,000 psia. When specified they can be furnished for installations in *corrosive* liquids or gases. Their leads can be exposed to temperatures up to 600°F. and may be detached from the instrument proper for shortening or easy replacement. Write for Bulletin 1370 to Trans-Sonics, Inc., Dept. 7.

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SPECIFICATIONS

CASE CONSTRUCTION: Stainless Steel
ACCURACY: ±1% of full scale range
PRECISION: ±0.2% of full scale range
MAXIMUM CONTINUOUS CURRENT: 20 ma rms (averaged over 1 second)
TIME CONSTANT: Less than 2.5 seconds in agitated water
ENVIRONMENTAL OPERATION CONDITIONS
PRESSURE: 3000 psia (at room temperature)
VIBRATION: 1" double amplitude, 0 to 22 cps ±25g, 22 to 2000 cps
SHOCK: 60 g in any direction, per para. 4.15.1 of MIL-E-5272A (10 milliseconds shock)

For Transducers, See Trans-Sonics

Trans-Sonics, Inc.

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For your copy of a fact-filled folder, write to:

Safeway HEAT ELEMENTS INC.

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AVIATION CALENDAR

(Continued from page 5)

June 7-8—30th Annual Homecoming & Reunion, Parks College, East St. Louis, Ill.

June 11-13—3rd Western Plant Maintenance & Engineering Conference, Civic Auditorium, San Francisco, Calif.

June 14—Plastics for Electronics, New England Section, Society of Plastics Engineers, Lowell Technological Institute, Lowell, Mass.

June 17-19—National Convention on Military Electronics, Sheraton-Park Hotel, Washington, D. C., sponsored by Institute of Radio Engineers.

June 17-20—Eighth All Women's International Air Race, McAllen, Tex.-Cuba. For details, write: Miss Irma Price, Entry Chief, 242 W. 8th St., Miami, Fla.

June 17-20—National Summer Meeting, Institute of the Aeronautical Sciences, Biltmore Hotel, Los Angeles, Calif.

June 23-25—29th Annual Meeting, Aviation Distributors & Manufacturers Assn., The Broadmoor, Colorado Springs, Colo.

June 24—Soviet National Aviation Day, Moscow.

June 27-29—13th Annual Meeting, Institute of Navigation, Sheraton-Park Hotel, Washington, D. C.

July 2-11—24th National Soaring Contest, Harris Hill, Elmira, N. Y.

July 6-10—Eleventh All-Women Transcontinental Air Race, from San Mateo County Airport, Carlos, Calif., to North Philadelphia Airport, Pa.

July 10-20—International British Plastics Exhibition, Olympia London Grand & National Halls, England.

July 12-13—British Lockheed International Acrobatic Competition, the National Air Races (third round and the King's Cup Air Race, Coventry Civil Aerodrome, Baginton, England.

July 28—Third Annual Jaycee Air Fair, sponsored by Aviation Committee, Portland (Oregon) and Junior Chamber of Commerce, Portland International Airport.

July 31-Aug. 4—Eleventh Annual National Convention, Air Force Assn., and Airpower Panorama, Sheraton-Park and Shoreham Hotels, Washington, D. C.

Aug. 6-10—National Aviation Meeting, Institute of Aeronautical Sciences, U. S. Grant Hotel, San Diego, Calif.

Aug. 10-11—Midget Airplane Races, Oshkosh, Wisc.

Aug. 20-22—Bendix-Scintilla International Ignition Conference, annual meeting, Sidney, N. Y.

Aug. 20-23—Western Electronic Show & Convention, Cow Palace, San Francisco.

Aug. 26-28—Gas Dynamics Symposium, Transport Properties in Gases at High Temperatures and Pressures, Technological Institute, Northwestern University, Evanston, Ill.

Aug. 31-Sept. 1—Midget Airplane Races, Ft. Wayne, Ind.

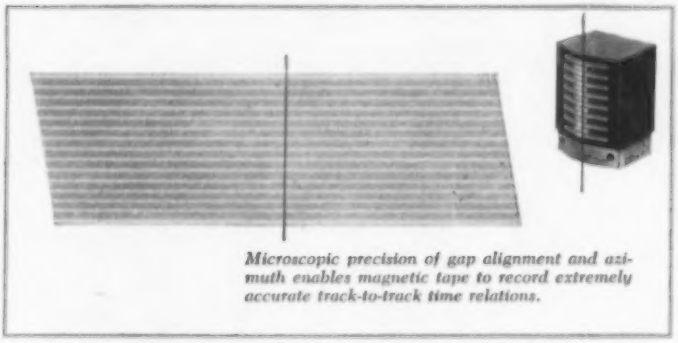
Sept. 1-15—Sixth International Aeronautical Conference, Royal Aeronautical Society and Institute of the Aeronautical Sciences, Folkstone and London, England.

Sept. 2-8—1957 Flying Display, Society of British Aircraft Constructors, Farnborough, England.

How many microseconds apart is "almost simultaneous"?

Here is how magnetic tape gets the answer

When things happen in the front of a jet engine, other occurrences in the rear follow in a flash – no pun intended, we mean in a fraction of a millisecond. Those who test jet engines have found that magnetic tape recording can be used to make a *milli*second look enormous – and to show even fifteen *micro*seconds as a significant interval. Transducers in key points in the front and rear of the engine feed parallel tracks on the tape. The amount of offset between parallel signals provides a measure of their relative timing.



Microscopic precision of gap alignment and azimuth enables magnetic tape to record extremely accurate track-to-track time relations.

For time correlation the head stacks on an Ampex Tape Recorder are like an "electronic tee-square." All of the gaps are in line within 1/10,000th inch. And gap azimuth is accurate to a minute of arc. Tape moves past the head at speeds up to 60 inches per second and multiplies the track-to-track timing accuracy accordingly. (But consult us at Ampex before you rely on simple arithmetical conclusions).

To read these time differences off in measurable form, the tape is reproduced at a small fraction of its original speed (1/32nd, 1/100th, etc. according to machine). It can be recopied onto another tape – be slowed down again – and then be recopied onto a visual recording on which small time intervals are magnified as much as 10,000 times.

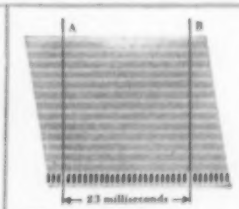
If to you this particular example is more spectacular than useful, note that it is only one of numerous talents that magnetic tape has in tying together data and time. Perhaps some of these others fit your needs.

Are you interested in reproducing data in precise real time? Ampex Servo Speed Control can reproduce data with original timing held within two parts in 100,000. It doesn't matter if the tape stretches a little, or if your input power fluctuates from 60 cycles. Servo Speed Control holds a precision signal on the tape in step with a precision time source. At any instant these signals will be in phase within a millisecond or less (depending on tape speed).

Maybe you like your data recordings referred to the time of day. In any of several forms of digital coding, such information fits nicely on a timing track. The time code designates hours, minutes, seconds and even the milliseconds between. Commercial equipment is available for search and control. It can run the tape quickly to any minute and second you designate – handy if your recordings accumulate by tens or hundreds of thousands of feet.

If quick, accurate measurement of time intervals from a fractional second to a few seconds in length are your interest, magnetic tape recordings can make the problem as easy as counting to 1,254,391 . . . on an electronic counter. A series of pulses or sinewave oscillations are recorded on a time track parallel to the data tracks. As many as ten thousand per second can be recorded accurately and reliably. Electronic counting of these pulses measures time intervals to a required precision. There is no strain on your patience or your eyesight.

Ampex Servo Speed Control equipment as used on the FR-100 Recorder.



Electronic counting on a timing track measures time intervals between data

If you are concerned with accurate timing of data and would like to know further of magnetic tape's advantages, we will be glad to furnish additional information. Others of magnetic tape's capabilities will be discussed in this continuing series. Would you like copies mailed direct? Write Dept. UU-3135

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3

ONE OF A SERIES

Series FR-100

Series 800 Mobile and Airborne

Model FR-200 Digital

Tape Loop Recorder

Series FR-1100

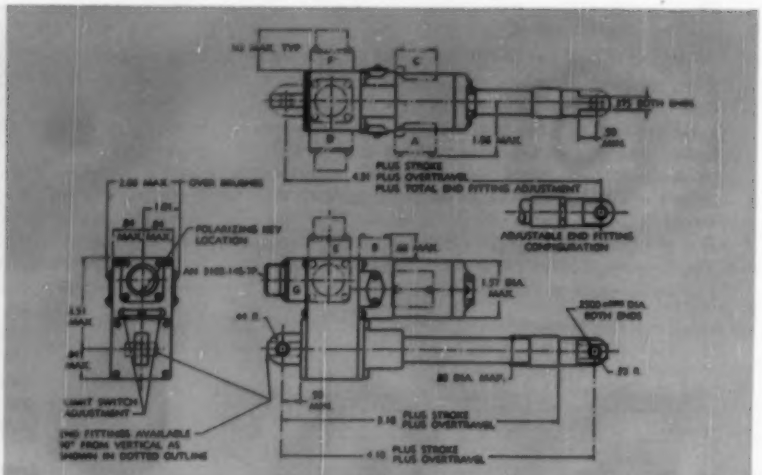
THE INFORMATION ON THIS PAGE IS TYPICAL OF THE DATA YOU WILL FIND IN THE NEW AIRBORNE CATALOG

650 LB. LINEAR ACTUATOR

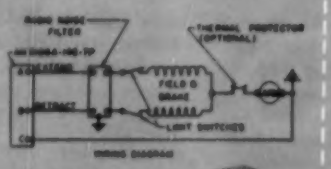
ONE OF OUR NEW SERIES OF HIGH-PERFORMANCE ACTUATORS

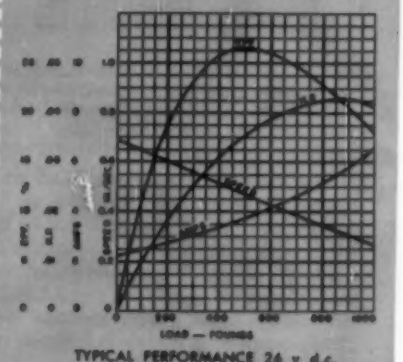
GENERAL ENGINEERING DATA:

1. 26-volt dc split field, series wound, reversible, intermittent duty motor with magnetic brake. Available with thermal overload protector.
2. Unit includes radio noise filter, limit switches externally adjustable through entire length of stroke, positive overtravel stops, overload clutch and antirotation device.
3. Maximum operating load—650 lb.
   Ultimate static load—1500 lb. compression for 12 in. maximum extended length.
4. Weight 1.75 lb.
   Plus 0.04 lb. x stroke in inches.
   Plus 0.04 lb. for thermal overload protector.
5. Dimensional tolerances ±.03 in., unless otherwise specified.
6. Dimensions given are minimum lengths for zero stroke. To determine minimum length for required stroke, add stroke, plus stroke overtravel, plus total end-fitting adjustment.
7. Available with 115-volt, 400-cycle single phase motor, ball-bearing screw jacks, load-sensing switches, position transmitters, position switches.

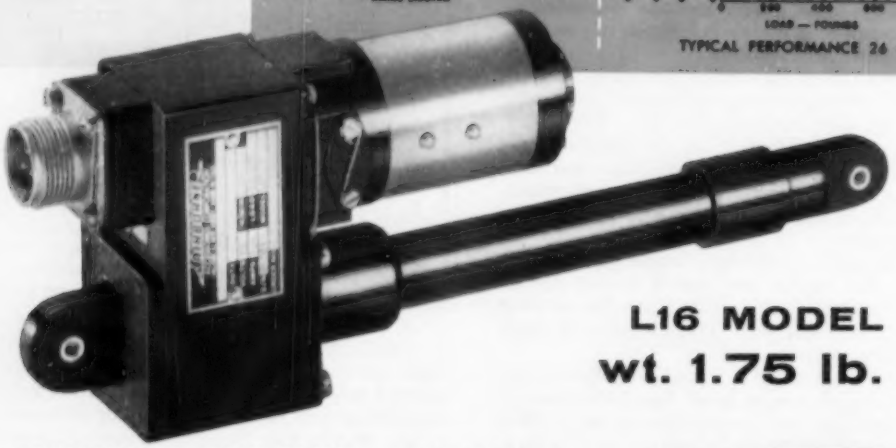


OPTIONAL LOCATIONS	
THERMAL PROTECTOR	CONNECTOR
A	D
B	E
C	F
	G





TYPICAL PERFORMANCE 26 v d.c.



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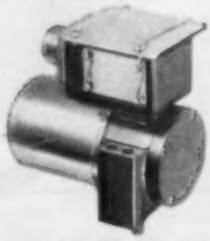
BARBER-COLMAN ACTUATORS

Barber-Colman standard and special actuators include rotary and linear types combining gear reductions, switchings, mountings, and other features to meet most applications in their load-speed class.



BARBER-COLMAN GYLC ACTUATOR

Lightweight Barber-Colman actuators chosen for Herman Nelson portable heaters

F-102A jets stationed in extremely cold climates have warm air supplied to their engines and electronic equipment by Herman Nelson portable heaters as illustrated above. To assure dependable operation of the control dampers on these heaters, Herman Nelson Division of American Air Filter Company has selected compact GYLC actuators by Barber-Colman Company. For help on your control projects, consult the Barber-Colman engineering sales office nearest you: Los Angeles, Seattle, Fort Worth, New York, Baltimore, Montreal.

CAREER OPPORTUNITIES: Excellent openings for qualified engineers.

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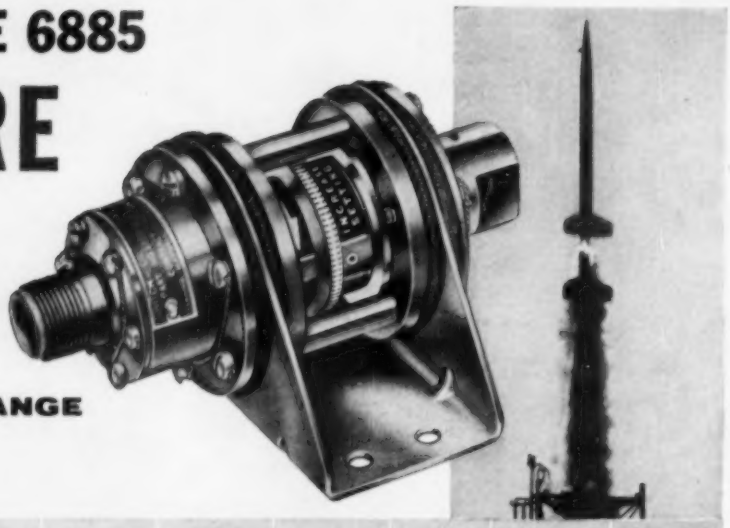
VERSATILE TYPE 6885 PRESSURE SWITCH

ONE BASIC DESIGN COVERS THE FULL RANGE OF APPLICATIONS



PRESSURE ADJUSTMENT RANGE	15 to 25 psia	0.25 to 4 psi	2 - 10 psi	10 - 50 psi	50 - 150 psi	150 - 500 psi	500 - 800 psi	600 to 3,000 psi	DUAL VERSION
ACCURACY OF SETTING (Under all test conditions)	±1 psi	±0.3 psi at 2.5 psi setting	±0.5 psi at 5 psi setting	±4% at 50 psi setting	±3% at 100 psi setting	±4% at 500 psi setting	±4% at 800 psi setting	±60 psi at 3000 psi setting	According to selected ranges
PROOF PRESSURE (Without setpoint drift)	500 psi	100 psi	750 or 4,500 psi (as required)	750 or 4,500 psi (as required)	750 or 4,500 psi (as required)	750 or 4,500 psi (as required)	4,500 psi	4,500 psi	250 psi
BURST PRESSURE	750 psi	450 psi	1,000 or 7,500 psi (as required)					7,500 psi	450 psi
TEMPERATURE RANGE	−75° F. to +250° F.								
VIBRATION	Up to 2,000 cps at 40 g. Exceeds MIL-E-5272A Procedure I								
OVERALL DIMENSIONS	Switch Proper – 2" Diameter; Length 4⅛". Mounting Bracket to Suit Application								3½" wide 4⅛" long
WEIGHT	9 Ounces							10.5 Ounces	16 Ounces
ELECTRICAL RATING	30 Volts, 2.5 Amperes Inductive Load at 50,000 Feet								

This pressure actuated switch is particularly designed for aircraft, rockets and missiles to control electrical circuits whenever the system pressure deviates from a specified value.

Integral vibration isolation between mounting bracket and switch body contributes greatly to exceptional performance under vibration and shock conditions. Switch performance remains well within the tolerance limits given in the above table.

The Type 6885 incorporates an enclosed snap-action switch, actuated by the movement of a limp diaphragm. *External* adjustment of the control set-point is easy with the unit installed for operation. Mounting position does not affect calibration, nor can pressures above the switch adjustment range deflect the diaphragm. The switch is immune to standard aircraft fluids and to corrosive media like oxidizers, rocket fuels, or Mil-O-7808 oil. Only Teflon and aluminum contact the pressure medium.

An alternate Type 6885 Pressure Switch has two independent sensing and switch elements inside two housings with a single electrical connector and one pressure port. The Type 6885 can also be supplied with two electrical switches for double-pole, double-throw, non-simultaneous actuation.

The wide range of operating pressures and functional perfection under vibration obtainable with the Type 6885 Pressure Switch recommends it for a variety of airborne applications. For engineering counsel, please address your inquiry to our headquarters plant, Danbury, Conn.

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it's the Super Ventura

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Any way you look at it . . . it's the Super Ventura.

For further information, write or call Charles Dye, Sales Manager

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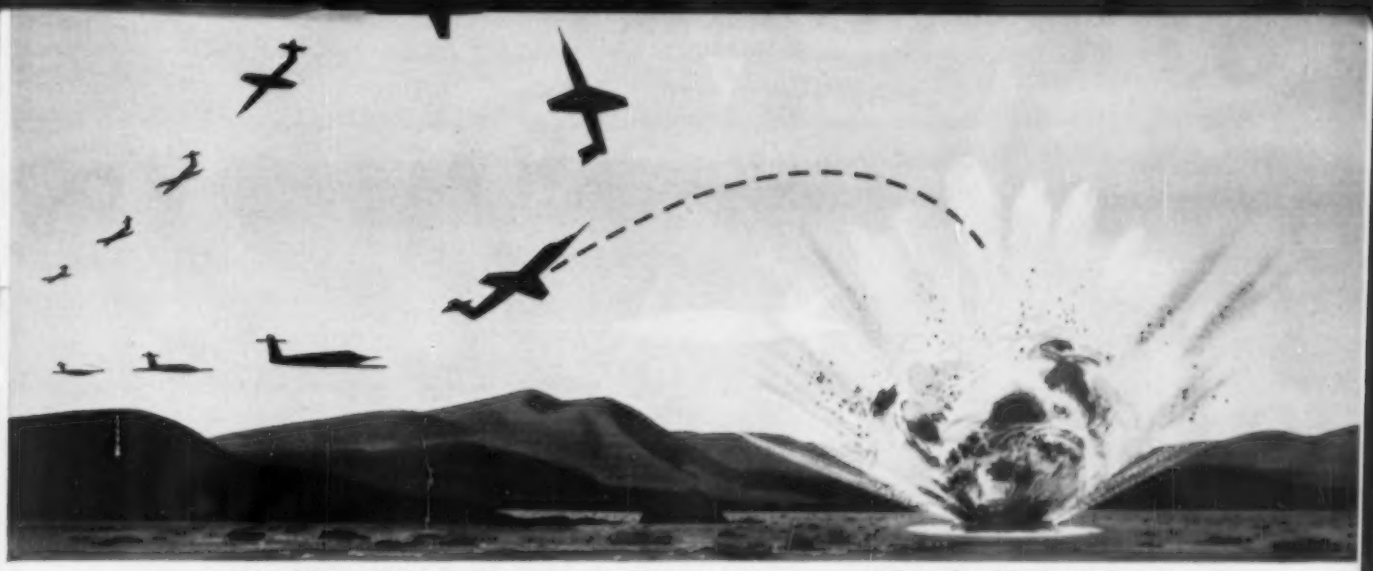
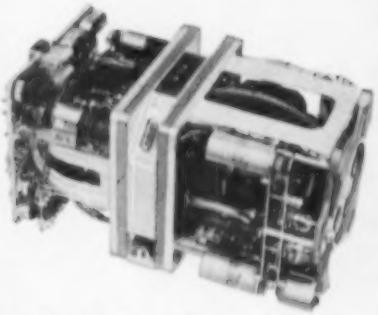


LOW ALTITUDE BOMBING SYSTEM—one example of how new 2-gyro system meets all-attitude stabilization requirements.

Satisfies stringent demands of MISSILES, too.

On ANTI-SUBMARINE WARFARE planes, new system eliminates DIRECTIONAL GYRO gimbal error and feeds error-free heading information.



Bendix 2-Gyro System weighs only 19 lbs. and measures only 6" x 6" x 12", including all amplifiers.

NEW! BENDIX 2-GYRO ALL-ATTITUDE CONTROL

basic reference for today's needs— saves 50% on cost and weight

This new 2-gyro system was specially developed by Eclipse-Pioneer to fill today's critical need for a *low-cost* master control reference combining vertical and directional gyros in continuous, high-precision performance through all attitudes and altitudes.

Extensive performance tests show the Bendix system's accuracy holds during rolls of 360° a second, loops of 80° a second and other high-rate maneuvers. Under test the new system has withstood 10G of vibration on its two horizontal and 1 vertical axes. Azimuth drift rate is 1° per hour maximum. Vertical drift rate is ¼° per minute maximum.

Bendix 2-Gyro All-Attitude Control will fully satisfy performance requirements in 90% of today's applications. And it offers the additional advantages of being half the cost and weight of 3-gyro systems.

This new 2-gyro system will be of interest in both commercial and military fields. Ask for details.

District Offices: Burbank and San Carlos, Calif, Dayton, Ohio; and Seattle, Wash.
Export Sales & Service: Bendix International Division, 205 E. 42nd St., New York 17, N. Y.

ADVANTAGES OF BENDIX 2-GYRO ALL-ATTITUDE CONTROL—

VERSATILE – *replaces all vertical and directional gyros used for indication, auto pilot control, navigation, fire control, radar stabilization and other functions.*

ELIMINATES DG GIMBAL ERROR.

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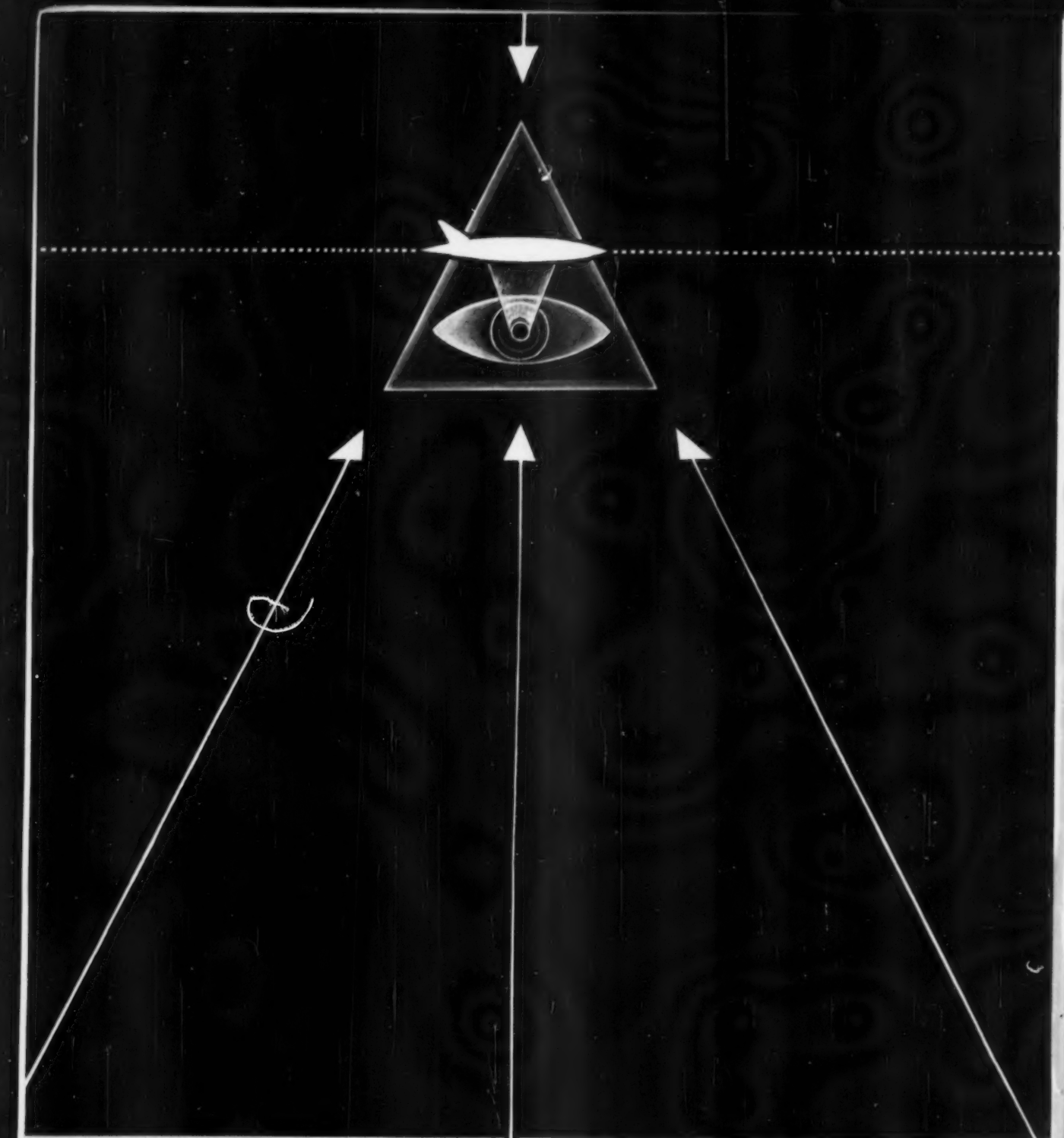

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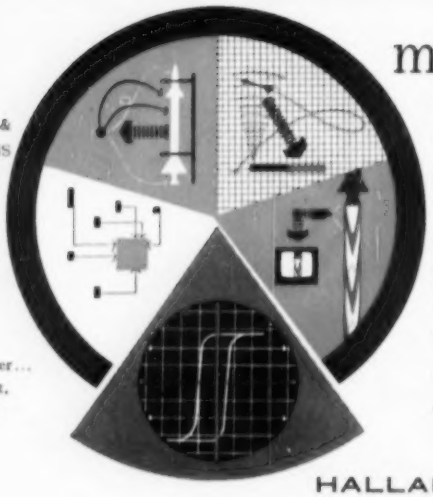

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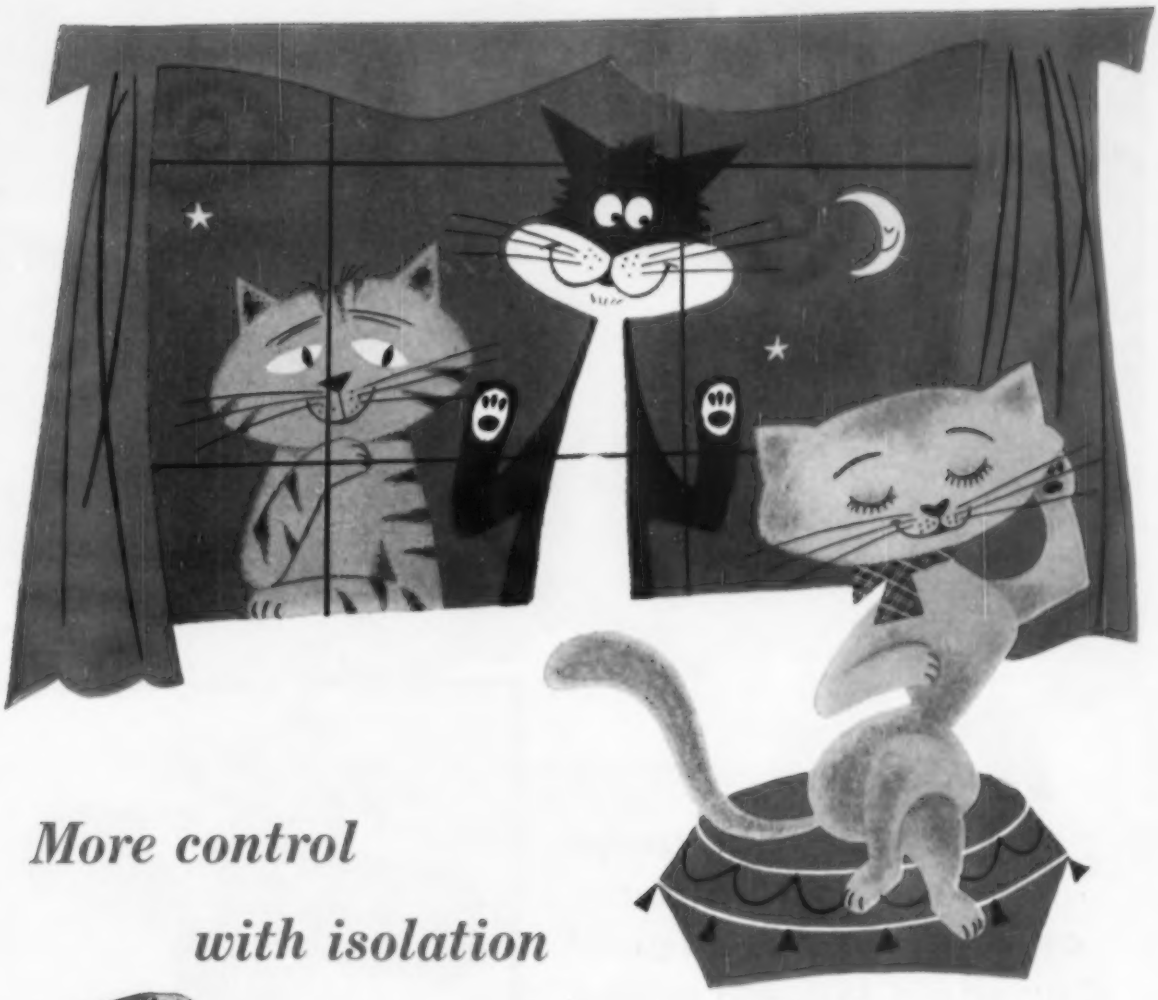

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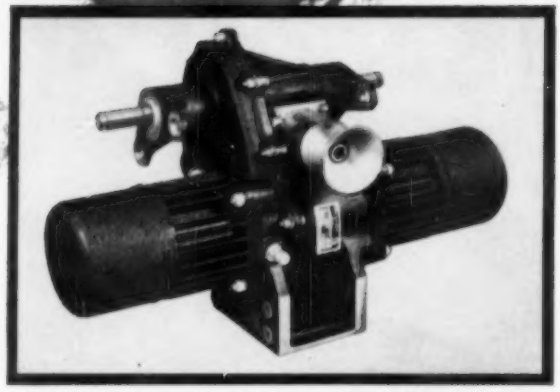

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May 20, 1957

AVIATION WEEK

Vol. 66, No. 20

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COVER: Ryan X-13 Vertijet approaches trailer bed landing platform in flight at Edwards AFB, Calif. Signaller on platform aids pilot in maneuvering single hook on X-13 nose onto cable on platform. Trailer is raised and lowered hydraulically for landing and takeoff (AW May 13, p. 29). Other pictures of the Jet VTOL flight are on pages 64, 65 and 67.

Picture Credits:
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AVIATION WEEK • MAY 20, 1957 • Vol. 66, No. 20
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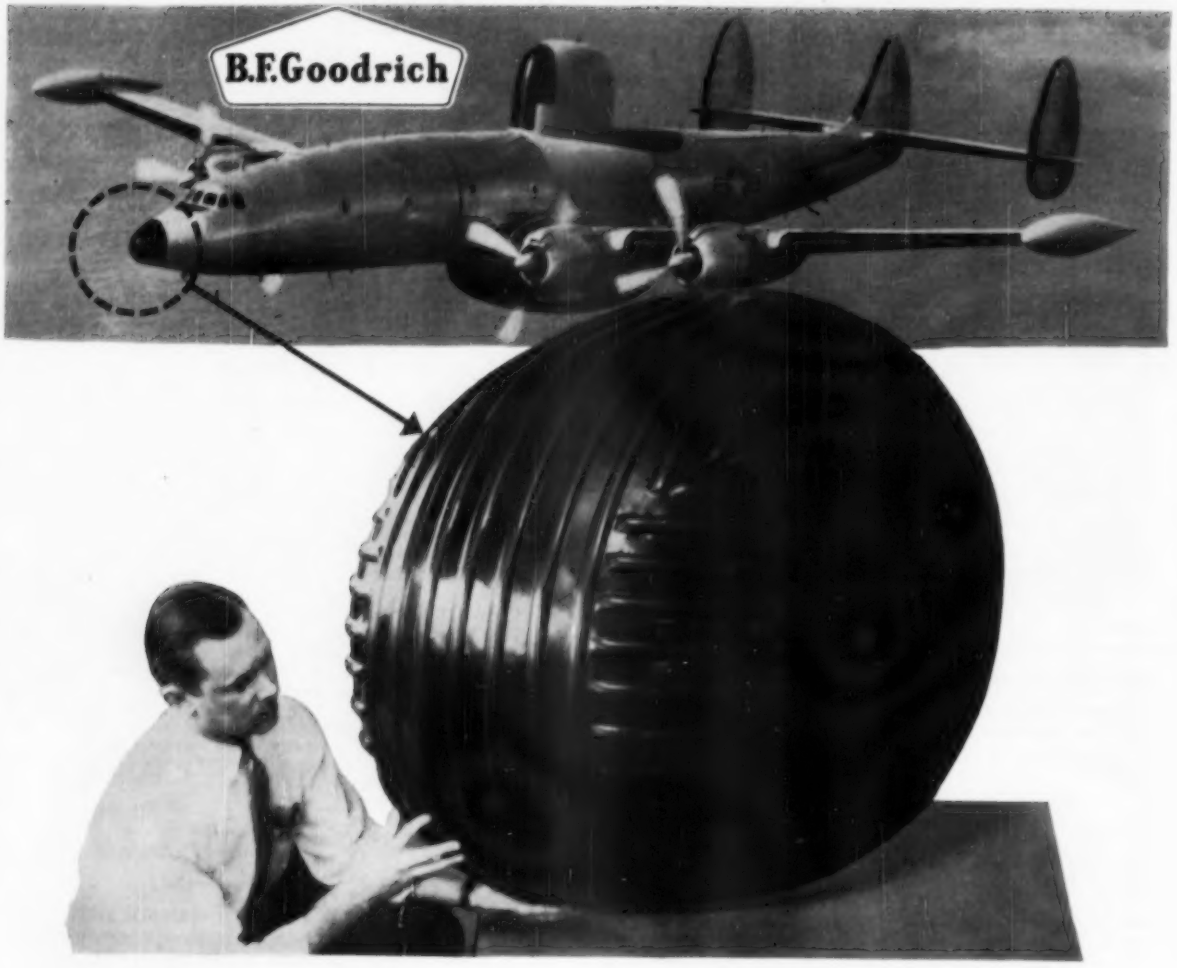
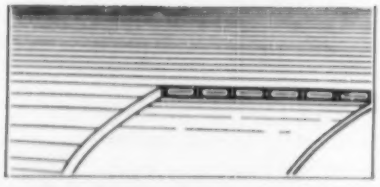


Pneumatic De-Icers keep radomes clear without distorting radar signal



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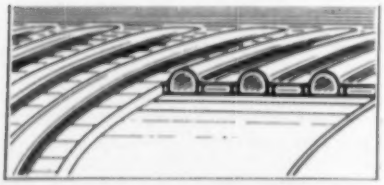

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EDITORIAL

New Federal Air Agency Needed

The final report of Edward P. Curtis, special aviation facilities planning adviser to President Eisenhower, strikes straight to the heart of the problem that has doomed all of the many postwar efforts to modernize the federal airways and traffic control system to failure. The cause of these many failures has been the dispersion of authority and responsibility throughout several federal agencies. Any effort to solve the traffic control problem inevitably bogged down in this morass of official red tape and bureaucratic buck-passing. Mr. Curtis states this fact in much more polite and diplomatic terms but this is the essence of what he means.

The Air Coordinating Committee was established in 1945 to try to solve this problem by providing an interdepartmental government council to make decisions on broad aviation policy and specific wrangles between agencies. However, ACC action can come only from unanimous decision and any single agency can use the veto power just as effectively as the Soviet Union in the United Nations Security Council. ACC has solved many minor aviation problems, but has been impotent in the face of any major issue that involved interdepartmental conflict.

New Agency Proposed

To solve this vexing problem, Mr. Curtis recommends creation of a new and all-powerful Federal Aviation Agency, details of which are described on page 26. This new agency, headed by a civilian but staffed by both civil and military aviation experts, would have full authority to implement federal aviation policy on air traffic control, navigation and safety regulation. It would also be the sole place where responsibility for getting these jobs done promptly and efficiently could be fixed. Like Mr. Curtis, we regard the growth of the federal bureaucracy with antipathy. But we must agree with him that this is a case where creation of a new federal agency is not merely desirable. It is mandatory.

Aviation has struggled with the current hodge-podge of dispersed authority and responsibility for ten years without making any substantial progress on the major problems that are restricting its growth and imperiling its safety. There is no hope in such debating societies as the Air Coordinating Committee, well-intentioned though they may be. Nor is there any hope as long as aviation policy is stifled under several layers of cabinet level bureaucracy and denied an independent voice to state its needs and offer its services to the American people.

We recommend that everybody concerned with aviation read the following passage taken from Mr. Curtis's report:

"The United States is becoming more and more an air community. During the last several years our national strategy has come to rest essentially on air power in its widening manifestations. The industrial skills devoted to air technologies now comprise the largest single pool in manufacturing.

"The airplane has become the prime mover of our population in its circulation over distances beyond 200 miles.

"These developments are changing the American way of life, our habits of work, our national outlook. If they are given room to follow their logical evolution they may well provide the principal sustaining elements to our social and economic well being as well as our national strength for years to come."

Clearly a technology that offers such potential in our national structure deserves an independent voice and a proper stature in the councils of our government.

There may be many minor points of difference among the various elements in the aviation spectrum regarding just what the new Federal Aviation Agency should do and how it should be done. There is a fine forum for these discussions before the proper Congressional committees.

Unified Support Needed

But all elements of aviation should get together now and support wholeheartedly the concept of the new Federal Aviation Agency as recommended by the Curtis report. For it will at last provide the proper sort of framework within which all of the elements in aviation can resolve their conflicts and push forward together in the directions that are vitally necessary to the proper growth of airpower and the economic health and international position of our country. The only alternative is another decade of chaos, muffed opportunity and artificially restricted technology.

We will have more to say later about the other detailed problems covered in Mr. Curtis's report. For the moment we would like to put on the record a resounding "well done" for Mr. Curtis and his staff who tackled their task with keen technical insight, threaded their way surely through the labyrinth of government and had the courage to face the issues squarely and present a positive blueprint for aviation progress.

—Robert Hotz

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Alfred J. Sherman, vice president-manufacturing, Monarch Machine Tool Co., Sidney, Ohio.

Gene Lowe, vice president-manufacturing, Benson-Lehner Corp., Los Angeles, Calif.

Honors and Elections

Charles E. Beard, president of Braniff International Airways, has been honored by the Peruvian Government with the decoration Order del Merito.

Sq. Leader Robert T. Heaslip of the Royal Canadian Air Force has been named 1956 winner of the McKee Trans-Canada Trophy, major Canadian aviation award, for his work on helicopter operations during construction of the Mid-Canada radar warning line.

Changes

Y. C. Lee, director-research and planning, Liquid Engine Division, Aerojet-General Corp., Azusa, Calif. also: **Robert J. Mill,** manufacturing manager.

Arthur E. Miller, director-research, Scott Aviation Corp., Lancaster, N. Y.

Raymond D. Gayner, manager-engineering operations, North American Aviation, Inc., Los Angeles, Calif.

Charles D. Harris, general manager, Utica-Bend Corp., Division of Curtiss-Wright Corp., Utica, Mich.

W. Douglas Wilson and **Herbert G. Bostrom,** product development engineers in charge of Agastat research and development dept., AGA Division, Elastic Stop Nut Corp. of America, Elizabeth, N. J.

Dr. J. Victor Hughes, associate scientist, Scientific Research Staff, Republic Aviation Corp., Farmingdale, N. Y.

Charles R. Strange, chief engineer, and **Anthony G. Puglisi,** assistant chief engineer, Tulsa Division, Douglas Aircraft Co., Inc., Santa Monica, Calif.

John P. Meldrum, manager-production programming and control dept., Ford Aircraft Engine Division, Ford Motor Co., Chicago, Ill.

Charles S. Ames, chief project engineer-Atlas ICBM, Astronautics Division, Convair, Division of General Dynamics Corp., San Diego, Calif. **Lloyd Munson** succeeds Mr. Ames as chief design engineer.

INDUSTRY OBSERVER

► First test firing of the Atlas intercontinental ballistic missile from Patrick AFB, Fla., is scheduled for May 29. Current biggest problem facing engineers working on the Atlas and Jupiter projects at Patrick is fuel slosh.

► **Possible successor to titanium in the high-temperature field has been developed by Dow Chemical Co. Designated magnathorium, the material has a magnesium base, contains 3% thorium, 1% zirconium. North American Aviation, Inc., is reportedly considering extensive use of magnathorium in its new A3J-1 jet attack bomber.**

► Latest missile battle between USAF and the Army involves rival systems for defense against the intercontinental ballistic missile. USAF Wizard system developed by Convair and Radio Corp. of America is being pitted against the Army's anti-missile concept developed by Bell Laboratories in an evaluation by Pentagon's Weapon System Evaluation Group and William M. Holaday, successor to Eger Murphree as Defense Secretary Wilson's chief adviser on missiles. (For USAF, Army positions on anti-missile potential, see page 30).

► **Ryan Aeronautical Co. has designs for a high-performance, supersonic Vertijet fighter or fighter-bomber as a successor to its X-13 jet VTOL test aircraft. Unlike the X-13 (see page 64), the aircraft would have all the outward appearances of a conventional fighter. Ryan engineers say it would have a turning radius of approximately one-fourth that of current fighters, could reach a 15,000 ft. altitude in the same time it would require a conventional jet to become airborne.**

► Convair Missile Division at Pomona has developed an infrared infantry weapon capable of being transported and operated by one man for use against targets such as tanks and low-flying aircraft. Designation is Redeye.

► **Mirror landing system has resulted in a sharp decline in Navy's aircraft accident rate at sea. One official estimates that the accident factor at sea is down almost one-third of what it was in the best year before the system was introduced. Overall, Navy improved its accident record by 13% during Fiscal 1956. Of the total, 58% were attributed to pilot error, 2.4% to maintenance personnel, 1.2% to supervisory personnel. Material failure was blamed in 35.9% of the accidents.**

► Air Force plans to cut outlays for expansion of industrial ballistic missile facilities by $70.9 million during Fiscal 1958, from $84.5 million in Fiscal '57 to $13.6 million. Industrial expansion program for aircraft nuclear propulsion facilities is also down, from $42.2 million to $14 million. On other facilities, USAF plans to spend $87.4 million in the aircraft and missiles field, $66.5 million on engine facilities.

► **Navy has further sliced its order for the Douglas F5D Skylancer. Contract now calls for only four aircraft. Original order for 19 was first cut to 11 (AW Feb. 25, p.84).**

► Cabin mockup of a Martin P6M SeaMaster has been shipped to Naval Ordnance Test Station, China Lake, Calif., for sled tests of the ejection seat system. SNORT track will be used, and 11 runs are planned for next month. Twenty-four rockets will propel the mockup. Ejection system successfully freed four Martin employes while SeaMaster was beginning an inside loop in crash of the second experimental model.

► **Tests of many materials—over 100 specimens—under temperatures of more than 4,000F—have been made for the U. S. Army at Redstone Arsenal through the use of a rocket exhaust. Publication of the findings is uncertain because no government agency wants to bear the cost.**

► Boeing B-52 consumes $330 worth of fuel and lubricating oil per flying hour. Fuel/oil costs for Convair's B-58 are $174; for the B-36 are $272; the B-47, $198; KC-135 jet tanker, $232.

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Washington Roundup

Military Pay Raises

Legislation designed to raise the pay of skilled military personnel along the lines of the recommendations of the Defense Advisory Committee (see page 34) have been placed in the congressional hopper despite Bureau of the Budget opposition.

Measures have been introduced by Sen. Stuart Symington (D.-Mo.), member of the Senate Armed Services Committee, and by Rep. James Van Zandt (R.-Pa), member of the House Armed Services Committee.

Noting that Ralph J. Cordiner, committee chairman and president of General Electric Co., has estimated that his proposed revision of the military pay structure would save $5 billion annually by encouraging career service and reducing turnover and training costs, Symington declared:

"Here then is a program, undertaken at the administration's expense by one of our greatest business managers, developed by experts, approved by the Secretary of Defense, members of the Joint Chiefs of Staff, and the Service secretaries, submitted to the Bureau of the Budget and pigeon-holed—despite the fact it does not require one cent of new appropriation in the present budget and yet gives promise of markedly improved national defense, with fewer people, and at less cost."

'Peril-Point' Budget

Defense Secretary Charles E. Wilson and his new deputy, Donald A. Quarles have taken a cue from the White House and are taking to the stump with speeches in defense of the budget.

Wilson told a Houston, Tex., audience his budget "is well within the capacity of the country to pay and will not in itself damage the economy . . . a good case could be made for increasing it somewhat . . . I have thought my taxes were too high for 25 years, but I haven't squawked about it . . . in my opinion it is a peril-point budget and should not be cut.

Quarles, more austere and less colorful, spoke in Virginia. Said he: ". . . The military budget as it stands . . . isn't large enough to provide all the things military people would like to see us provide as a means of maintaining (our) relative (deterrent) position . . . our requirements for protection are very much broader than merely the creation of an air atomic retaliatory force. . . . We must also protect ourselves against nibbling operations and against the covert tactics of infiltration and subversion . . . this is why we have a military assistance program."

Skyrocketing Vanguard Costs

Elevation of William M. Holaday to a post as the Pentagon's new missile czar is significant mainly because of the supervision he has been given over the Vanguard earth satellite program, previously operated more or less as a Navy show.

The reason: Defense Secretary Wilson wants to keep a closer eye on how the money is spent, before the spending goes higher than Vanguard's orbit. Thus far, the project has cost $57 million, $37 million of which came out of the defense budget. Expenses will hit $65 million by the end of August, and there are hard-shelled skeptics who say the total after another and necessary 18 months may hit $200 million.

None of this is for a weapon system's development, and Wilson is opposed to using his money for this kind of research or technological rivalry with the Soviets. Holaday, an assistant to Dr. Clifford C. Furnas when the latter served as Assistant Defense Secretary for Research and Development, will watchdog the Vanguard. Despite Navy denials, the project has not been progressing as fast as expected.

It is greedy for talent and facilities in addition to dollars and is committed to a tight schedule. If Vanguard works, it must do so before the end of 1958.

Research and Development

U.S. Chamber of Commerce's energetic drive on Capitol Hill to have all research and development funds allocated to the Office of the Secretary of Defense is being opposed with equal energy by the three services.

Claiming that such a move would open the way for a major saving in the defense budget, the Chamber reported to House Appropriations Committee: "There are now, in effect, three competing programs, based not so much upon research to improve the technology of weapons as upon the desire of each service to prove that it should assume the principal strategic and tactical role. . . ."

Air Force retorted in a report to the committee: "The assignment of all research and development funds to the Secretary of Defense would only delay the execution of a research and development program and would degrade its management efficiency.

By virtue of its organizational location in the structure of the federal government it would be impossible for the OSD to provide the detailed management needed to conduct a dynamic military research and development program.

It also would create complex administrative problems in the command and administration of research and development facilities."

Off Again

Despite prior assurances to the contrary, there was no meeting of the Defense Science Board on May 15. The originally scheduled session of top research experts was called off when they found that Assistant Defense Secretary Frank D. Newbury did not appear to want their advice (AW April 15, p. 26). Two weeks later, following public disclosure of Newbury's rift with the board, he submitted his resignation, insisting that the scientists would meet on May 15 and that the agenda was ready (AW April 29, p. 27).

Now the session has been canceled again, pending selection of Newbury's successor. Board probably will not convene until next fall.

Army Plans

Army planning calls for a total of 6,038 aircraft during Fiscal 1958—5,156 on hand and 882 on order. The total dollar volume is $489.5 million: $367.7 million for aircraft on hand, $121.8 million for aircraft on order. This compares with:

Fiscal 1957—5,722 aircraft costing $433 million, 4,504 on hand and 1,218 on order.

Fiscal 1956—4,972 aircraft costing $366.8 million, 3,628 on hand and 1,344 on order.

—Washington staff

Curtis Wants New Agency, End to CAA

All-powerful Federal Aviation Agency would absorb CAA, confine CAB to economic regulatory powers.

Washington—Formation of an all-powerful Federal Aviation Agency that would absorb Civil Aeronautics Administration and strip Civil Aeronautics Board of all but its economic regulatory powers has been recommended by Presidential assistant Edward P. Curtis.

In his final report presented to the White House last week, Curtis called for an end to the over-complex structure of present aviation agencies and for closer cooperation between civil and military aviation. The sweeping recommendations for a complete reshuffling of present aviation functions include the replacement of the Air Coordinating Committee with an aviation policy council, as advisory group to the proposed Federal Aviation Agency. Target date for the program is 1960.

Task Completed

The report of the Aviation Facilities Planning Group headed by Curtis is the result of studies conducted since February, 1956, under instructions from President Eisenhower. Last month, the group issued its recommendations for an air navigation and traffic control system that is incorporated in the final report (AW April 29, pp. 38 & 39). His task completed, Curtis is expected to move out of his job within the next six weeks.

Specifically, the Curtis report includes these recommendations:

- **Immediate formation** of an interim Airways Modernization Board consisting of a chairman appointed by the President, a Defense Department and a Commerce member (AW April 8, p. 26). The Board will conduct tests and studies for the development of an airways system that will serve both military and civil aviation in peace or war. A bill to create the Board as an independent agency is now before Congress.
- **Creation of a permanent** independent agency, the Federal Aviation Agency, headed by an "outstanding" civilian and staffed by both military and civilian personnel. The agency would consolidate all management functions necessary to support the common needs of military and civil aviation. It would incorporate the activities of the proposed interim Airways Modernization Board which would then be dissolved.
- **Head of the agency** would be directly responsible for the development of major U.S. aviation policy and long-range plans of implementation as well as supporting budget requests. CAA would be absorbed by the agency, but FAA would not interfere with the economic regulatory powers of the CAB nor the basic functions of the Departments of Defense and State and other interrelated agencies.
- **Assignment of all U.S. airspace** will be the responsibility of FAA.
- **Accident investigation functions** will be removed from the CAB and placed under the jurisdiction of FAA.
- **Civil Air Regulations** will be transferred from the CAB and CAA to FAA.

Curtis warned that the cost of his proposed long-range program would exceed the present level of expense for government aviation functions. In this regard, he cautiously approached the ticklish problem of user charges and suggested that "in practice, if not in law, the airway user charge is already under way."

Gasoline Tax

He reasoned that the existing two cents federal tax on aviation gasoline is, in effect, a user charge and urged that prompt legislation be enacted to classify it legally as such. The gasoline tax on motor vehicle operators which is now treated as a highway user charge under the Highway Revenue Act of 1956 was cited by Curtis as an example of a proper application of fuel taxes.

Curtis admitted that an accurate measurement of airways and navigational use of airways is difficult to attain. Lack of relationship between cost of airways operation and benefits to the individual user further complicates the problem of arriving at an equitable charge for services, he said.

High rate of fuel consumption on jet transports may prevent an across-the-board fuel tax from being a fair user charge, he said. He also noted that "there is a need for assuring coordination between the government's executive function of financing the airways, on the one hand, and its regulatory function of controlling airline fares, on the other" in assessing common carriers.

Plan for User Charges

Curtis' recommendations for handling the user charge issue:

- **Adoption of the two cents** as a user charge. If some other method is applied for charging user fees, then the existing tax should be repealed.
- **Prompt consideration** should be given to an orderly increase of existing user charges. Curtis suggested that the final decision on the method of increase should be made after the Commerce Department completes the study it is presently conducting on the issue.
- **Continuing attention** should be given to problems associated with the long-range aspects of the user charge program and procedures should be established to assure coordination between the user charge plan and the regulation of airline fares.

Curtis commended the Air Coordinating Committee for its past activi-

Curtis Proposal Reaches Senate

Washington—Senate Commerce Committee is expected to approve legislation establishing the three-member Airways Modernization Board proposed by Presidential Assistant Edward P. Curtis (AW April 8, p. 26) as "a step forward" in developing a joint military-civil air navigation facilities program. The Board would be composed of the secretaries of Commerce and Defense or their representatives and a chairman appointed by the President.

Major objection of committee members is that there is no requirement on the part of either the Secretary of Commerce or the Secretary of Defense to put the board's proposals into operation. Curtis agreed that "no one short of the President can tell the Secretary of Commerce or the Secretary of Defense to do something they don't want to do."

However, Sen. Warren Magnuson (D.-Wash.), chairman of the committee, said the three-man board, with statutory authority and its own funds, would at least be a step forward from the generally stalemated Air Navigation Development Board composed of only Commerce and Defense Department representatives. Sen. John Bricker (R.-Ohio), ranking Republican on the committee, said the board is "the best possible solution to a difficult matter."

Thus far, however, the House Commerce Committee has been antagonistic toward the plan (AW April 22, p. 40). It also is being opposed by the Air Line Pilots Assn. which wants a single "dictator" with authority to put a navigation system into effect on his own say so.

First F-105 Flight Photo Reveals Design Detail

Details of Republic F-105B Thunderchief masked out by retoucher's brush in its first picture (AW Mar. 25, p. 27) include dorsal fin extension near fuselage, actuators for Pratt & Whitney J75 turbojet engine afterburner. First flight picture also shows stationary root or fairing for the stabilator painted out in earlier view. Dorsal fin was shown, however. Intakes are in wing root extensions. Configuration may include horizontal splitter, outboard fence fairing into fuselage to form triangular shape. Area-rule fuselage is 60 ft. long with weapons bay in belly under wing carry-through. Span of thin, swept wings is 30 ft. F-105 is designed as a weapons system capable of missions either as a fighter-bomber or interceptor. A photo-reconnaissance version also is being produced. Flight program has begun at Republic's Farmingdale, N. Y., plant. For first pictures of J75 powerplant, turn page.

ties in solving "literally thousands" of conflicts but added that most such cases were on the local level. "Neither the major policy problems nor the necessary forward planning have received attention commensurate with the rapid expansion of U.S. aviation."

Curtis urged that the aviation policy council, which he wants to succeed ACC, serve as a communications funnel to the FAA from other interested agencies on national aviation policy.

Curtis described the consolidation of present military and civil air traffic, navigation and communications system as a major step in modernizing the airways. "Under joint management, a considerably greater degree of safe handling of air traffic could be realized, and undoubtedly some economy in cost as well," he said.

Appointment by the President of a special assistant to implement the airways plan and prepare policy and legislation prior to the organization of FAA was proposed by Curtis. The special assistant would serve as a non-voting member of ACC during the interim period and would develop a plan to find solutions to the many serious problems facing aviation in addition to the airways systems problem.

Curtis said preparation of legislation and coordination of all functions into the new agency can be accomplished in a maximum of three years.

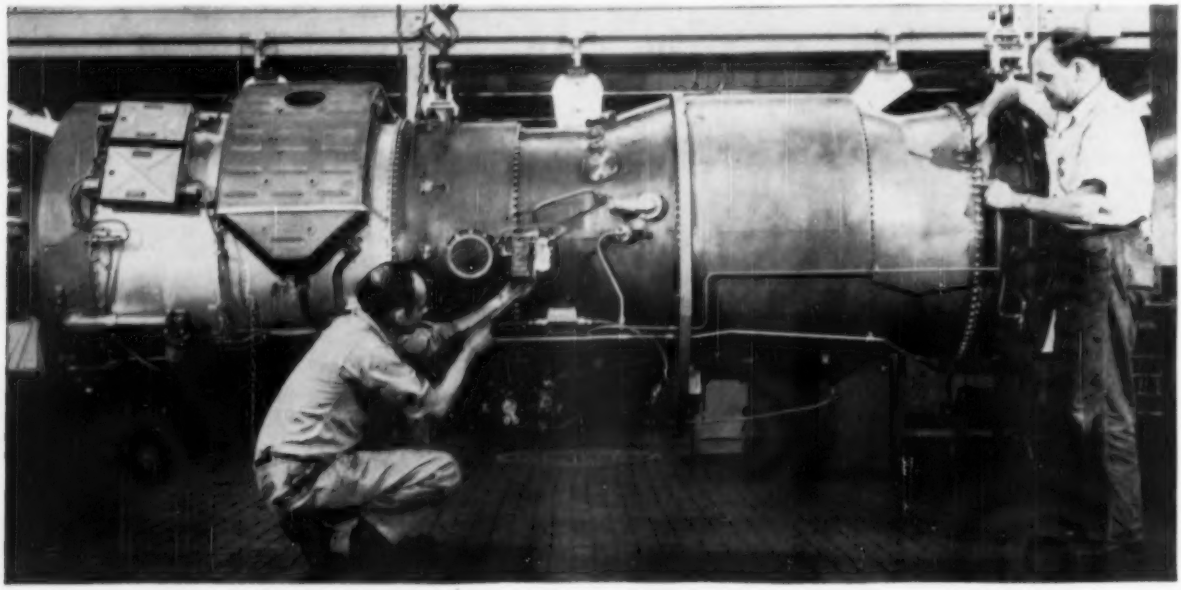
The special assistant will determine the maximum number of operating agencies engaged in air traffic control that can be consolidated within the Federal Aviation Agency.

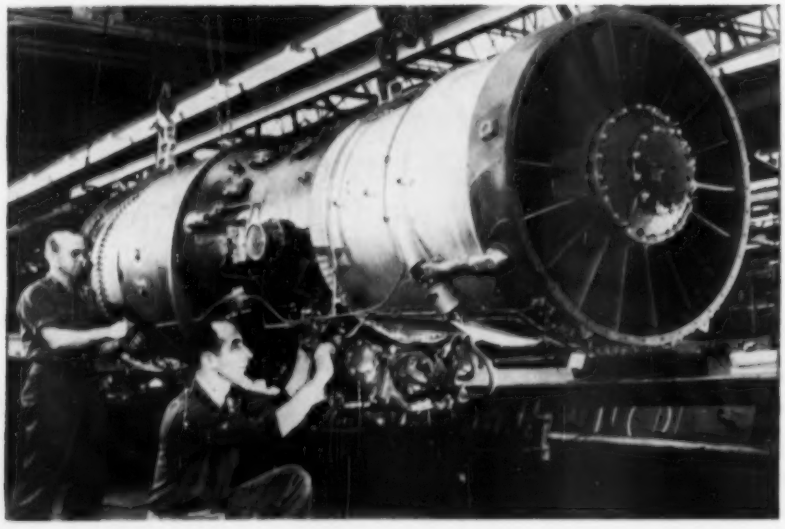
Curtis said the special assistant should also study weather services and determine clearly-stated aviation requirements and the best ways of supporting and strengthening these services.

He called for the development of policies that would establish clearer standards on the need and use of radio frequencies; asked for a "rapid re-inventory" of allocated channels and urged that obsolete channels be recaptured and reassigned to new uses immediately.

Curtis criticized present accident investigation procedures because of lack of a CAB field staff sufficiently large or competent to anticipate potential accidents and recommend preventive measures.

He charged that investigations were conducted at "a very slow pace" and said that specific follow-up is "not a clear, responsible action assumed by any one agency." He warned that responsibilities in the accident investigation field are "diffuse" and that lessons





J75 Turbojet Unveiled

Pratt & Whitney J75 turbojet engine, at East Hartford, Conn., plant in these first photographs, shows resemblance to its predecessor engine, the J57. Although only slightly larger than the J57, the J75 produces nearly 50% more power, Pratt & Whitney said. Dry static thrust without afterburner is 15,000 lb. Like J57, the J75 is an axial-flow, split-compressor engine. It has low specific fuel consumption and a lower specific weight than J57. Besides the F-105 (see previous page), the J75 will power the Martin P6M-2 SeaMaster, Convair F-106. Commercial versions are scheduled to power the Boeing 707 and Douglas DC-8 transports.

learned from air accidents that reveal outmoded safety regulations do not result in prompt corrective action.

He said the Federal Aviation Agency should handle all accident investigations and should be responsible for air operations, modernization of the airways, safety rule-making and enforcement. The agency, he added, also should be responsible for the "investigation of military air accidents involving civil-military aircraft or civil property."

Curtis called the division of responsibility between the CAA and CAB in issuing and administering safety regulations an "unusual situation" since it is normal practice for a single agency to create and enforce regulations.

He said neither the CAA or CAB has accepted leadership in adjusting regulations to accommodate high-performance aircraft. He emphasized that Civil Air Regulations should be issued, written and amended in the name of the head of FAA who should assume full responsibility for them.

Curtis said he was unable to place a "price tag" on the long-range program but pointed out that the Airways Modernization Board will be responsible for developing the program in detail for normal budgetary review by the President and Congress prior to the organization of FAA.

Airports, he said, should be sponsored by local governments with the federal government participating.

Here is how Curtis defines the FAA:

"The new agency is intended to centralize the responsibility for policy, operations and modernization of this (air) national service so as to permit a safe expansion of aviation to meet the demands of the public and the military functions important to us all."

Users Endorse Curtis Plan — With Some Reservations

Los Angeles—First public reaction of eight industry and military groups to the airways plan proposed by Presidential special assistant Edward P. Curtis indicated general agreement with the proposals, subject to a number of qualifications.

Members of the Airspace Users Panel who spoke officially for their organizations last week at the joint spring symposium here of Radio Technical Commission for Aeronautics and Institute of Radio Engineers were Col. L. S. Lightner, USAF; Capt. G. Van A. Graves, U.S. Coast Guard; Max Karant, Aircraft Owners and Pilots Association; William K. Lawton, National Business Aircraft Association; Col. Eric Osborne, USA; H. I. Rothrock, USN; J. D. Smith, Air Line Pilots Association; C. F. Timmerman, Air Transport Association.

Agree in Principle

All members of the panel agreed in principle with the proposed airways system, each noting their areas of qualified endorsement.

Lightner said USAF concurrence especially notes the Airways Modernization Board's power to select particular hardware to carry out the common system. The Air Force representative also noted that USAF programs in the field will be handed to the board as will those of other services, reducing duplication of effort and expenditures.

"Anything which furthers efficiency and adequacy of air traffic control will be helpful to USAF."

Speaking for the Coast Guard, Capt. Graves said any equipment which will enable aircraft calling for help to accurately pinpoint its position will help the Coast Guard in its normal functions of search and rescue. Such equipment would also benefit USCG itself in its coastal patrol activities, by increasing the accuracy of aerial navigation in general, he said.

Karant noted that AOPA approves of the report and recommendations in principle, but wonders how ordinary pilots are going to be able to fly in the complex structure proposed. AOPA feels the common system is a Utopia, and today does not believe that all the airspace above 18,000 ft. should be controlled. This is reserving too much valuable airspace, Karant said.

NBAA's Lawton commented that "the Sunday afternoon pilot is usually ill-equipped and ill-mannered." He went on to say that the conception of Curtis' plan meets NBAA requirements, and is to be endorsed. However, he emphasized that NBAA will watch closely the development of hardware accompanying implementation of the plan.

Army has 3,000 aircraft, mostly light fixed-wing planes and helicopters, Col. Eric Osborne reported. That part of the Curtis proposal calling for high order terminal navigational accuracy, fits well into Army operations with these aircraft types. The proposed hyperbolic navigations system for precise terminal area navigation looks very good, Osborne added. However, for its tactical mission, the Army needs a large amount of uncontrolled airspace, an area in which the Curtis proposal calls for "see-and-be-seen" philosophy.

While Navy agrees with the common concept, it has certain specialized requirements which must be met, Rothrock said. Navy cannot continue to load the topside of its ships with ever increasing amounts of equipment. Also, movements of its tactical aircraft, like those of the other services, are already extremely dense. Any equipment installed under the common system concept must be compatible with either an air or shipborne component or whatever navigational system the Navy needs to carry out its wartime mission.

A common problem in the Navy, Rothrock added, is the constant change in requirements. When the Harding report was issued, Navy prepared a statement on its stand. It was thought that the same statement, dusted off and updated, would suffice for Navy comment on the Curtis plan. But such a complete change in requirements has occurred in the meantime that the Harding report comment proved totally unuseable in connection with the Curtis proposals, he said.

Rothrock added that an absolute must in Navy's view will be a thorough study of long-term requirements, before systems are completely frozen, minimizing chances that complete reorientation might be necessary half-way through equipment development programs. Concerning use of today's airways system, Rothrock pointed out that only a certain amount of propping up and modification of an already outmoded system can be accomplished.

Two Questions

ALPA posed two questions. Smith asked what steps are being taken immediately to relieve today's critically dangerous air traffic situation; and, because the Association claims it was not thoroughly briefed on the Curtis activity and plans, he asked for designation of the proper agency or individual with whom to register complaints.

The traveling public, Smith said, knows when it wants to travel and how it wants to go, and this is the controlling factor in all airline operations. Experience has shown that the airways system must be capable of accommodating the travelers' desires.

In addition, ALPA is not convinced that fullest utilization is being obtained from today's air traffic control facilities.

Speaking for ATA, C. F. Timmerman said that one of the biggest lessons to be learned from the Curtis report is that it contains no miracle ingredients for solving the air traffic problem. Instead, it starts with improving and modernizing today's system, and plans ahead for future needs. It is hoped that this time everyone will get behind the proposal and see that it is carried through, in contrast to such past activities as ANDB, the Air Transport Association spokesman said.

Mahon Moves to Trim Missile Projects

By Katherine Johnsen

Washington – House Appropriations Committee is leading a congressional move to hold down future defense costs by cutting the number of active guided missile projects.

An investigation by the committee staff, according to Rep. George Mahon (D.-Tex.), shows that the Defense Department has failed to provide "an effective organization for the evaluation of missiles."

Mahon, chairman of the Subcommittee on the Armed Services, charged that in the event of an attack–now or within the next four or five years–there would be "a considerable degree of pandemonium because there are so many weapons."

"With all this air clutter with missiles and manned airplanes and rockets," Mahon said he doubted there could be enough selectivity to handle the situation.

SAGE Focus

In hearings before Mahon's subcommittee, Reuben B. Robertson, former Deputy Secretary of Defense, countered that the Semi-Automatic Ground Environment (SAGE) system would provide a focal point for obtaining "the knowledge to keep you from shooting at your own planes."

Mahon also charged that Defense Department decisions to proceed with various missile projects seem to depend upon "briefings and presentations made by admittedly prejudiced groups, such as the sponsoring service and the contractor."

The staff study shows, he said, that "decisions appear to rest to a large extent upon whether a particular missile can be made to operate, with insufficient attention being devoted to evaluating the need for a particular weapon as part of the overall defense plan."

Optimism expressed by Lt. Gen. James M. Gavin, Army chief of research and development, regarding the possibilities for development and deployment of an effective anti-intercontinental ballistic missile weapon was not shared by Deputy Defense Secretary Donald A. Quarles, then Secretary of the Air Force. Quarles agreed that an anti-ICBM could be developed but said its development would be so costly that it might be preferable to channel the funds into offensive missiles for a "deterrent" type defense.

The committee's staff criticized a lack of coordination and delineation of responsibility between Army and USAF efforts toward finding an effective anti-ICBM.

Gen. Gavin told the committee, "We cannot accept the ICBM as the absolute weapon, because it is not . . . The defense against them is just as feasible of attainment if we get on with it." The Army is putting "the largest number of our research and development dollars" into the anti-ICBM program, Gavin disclosed. Its research and development budget for Fiscal 1958 is $410 million.

Anti-Missile Optimism

Gavin said he is "optimistic" that an anti-ICBM can be developed "with a very high" percentage of kill. "It's the Army's mission to develop it, and we are quite confident of getting the missile to defeat the missiles."

Quarles agreed that "it should be possible to develop an anti-ballistic missile missile" but added:

"My pessimism or my lack of conviction–at the moment comes at the point where you start deploying this system and then you are confronted by the very difficult problem of how to apportion your resources between a striking force to give you defense by deterrents and a defensive force to give you active defense against the other fellow's strike. At that point we would want to measure the cost of the defensive system very carefully and make sure it was a wise use of our resources. . . ."

Quarles emphasized, however, that "I do not have any disagreement at all with the view that we should proceed energetically with scientific work to try to devise ways and means of creating such a defense."

Navaho vs. Snark

Rep. Mahon said "it appears to the Appropriations Committee that dollars (earmarked for the Snark air-breathing intermediate range missile) might be more profitably used for the more advanced weapons such as the Navaho (also an air-breathing intermediate range missile)." He added that this opinion is also held by Eger V. Murphree, former Special Assistant for Guided Missiles, who reported that the Snark program is "a questionable one," by Gen. Curtis LeMay, who "has frequently and consistently favored its cancelation," and by Maj. Gen. Howell M. Estes, Assistant Deputy Commander for Weapons Systems, Air Materiel Command.

"Each year," Mahon said, "the operational readiness date continues to slip. . . . We are advised that the inventory life for the Snark will probably be very short since the arrival of the Navaho. The Atlas and the Titan will make the Snark obsolete. . . ."

Observing that the position of the Air Staff "is not exactly in the direction of Gen. LeMay's view," Robertson indicated that it will be possible to activate a Snark squadron by the end of calendar 1958.

Because of this, Robertson explained, "we felt that this is a weapon in which we had such a large investment that we should go ahead and get it in the inventory. While it has its disadvantages of being subsonic, it will probably have quite an accurate guidance system as is now visualized. . . ."

Thor vs. Jupiter

Assistant Secretary of Defense W. J. McNeil, comptroller, assured the committee that "there will have to be decisions this year" on two intermediate range ballistic missiles–Thor and Jupiter–as well as the two intercontinental ballistic missiles–Atlas and Titan. "As a result," McNeil said, "we

USAF Missile Procurement

A detailed breakdown of USAF's $1.9 billion missile procurement program for Fiscal 1958 discloses that almost half of the funds will be used for three ballistic types–Thor, Titan, and Atlas. Details reported to the House Appropriations Committee:

(in millions)

	1956 FY	1957 FY	1958 FY
Ballistic Missiles, total:	$307.9	$882.4	$955.7
Missiles	267.0	659.4	676.9
Missile spares	11.6	15.7	37.5
Ground handling equipment	29.3	203.6	234.6
Center support	....	3.7	6.7
Other Missiles, total:	689.5	1,286.4	994.8
Missiles	551.8	1,016.4	737.9
Missile spares	32.6	81.1	68.2
Ground handling equipment	105.1	188.9	188.7
Total Missile Program	$997.4	$2,168.8	$1,950.5

may devote our attention to one of each."

Dr. Wernher von Braun, director of development operations, Army Ballistic Missile Agency, said the Jupiter "utilizes a great number of components that are already used in the Redstone missile and are therefore tested and proven. This alone gives a certain advantage" over the Thor.

Maj. Gen. John B. Medaris, commander of the Army Ballistic Missile Agency, added that "there is nothing to indicate that the balance of the project from this point on is other than a straight-forward completion of a sound missile based on a combination of components, experience, and concepts that have been proven to be feasible at the present time."

There is "serious question," Mahon said, that the Bomarc-SAGE system as a successor to manned interceptors "will make a contribution to our air defense picture commensurate with its costs."

Committee skepticism is partially based upon an Army contracted study by the Operations Research Office of Johns Hopkins University which pointed out its vulnerability to jamming by counter-measures.

Rep. Mahon suggested that the anti-ballistic missile programs, the Bomarc-SAGE program, and others "might run the total picture $50 billion or $100 billion for the defense of the U.S."

Robertson agreed that "unless we are able to adjust them downward, the costs of these systems that will be coming on for continental defense alone will more than double."

Army will not abandon the Nike-Hercules ground-to-air missile system "as of this moment," Gavin reported. Introduction of Talos into the system later, he said, depends on whether funds are available.

Murphree told the committee that " a careful study of the Nike-Hercules and Talos developments has shown no predominant advantage for either system, and there may be sound reasons to use both systems operationally."

The Army said it has used no Fiscal 1957 funds for procurement of the predecessor Nike-Ajax missile, has canceled 300 on contract and is contemplating cancelation of 400 more.

Atomic Missile Firing

Washington—Atomic Energy Commission will conduct the first firing of an atomic air-to-air missile complete with warhead during the current series of tests at the Nevada Proving Ground. The missile, Douglas' MB-1 previously designated the Ding Dong, probably will be fired from an Air Force interceptor at a pilotless drone.

Beaten To ICBM Punch?

The Soviet Union has apparently beaten the United States in the race to flight test the first intercontinental ballistic missile.

Intelligence sources that have accurately charted the course of Soviet development on a 900-mile-range ballistic missile (AW March 12, 1956, p. 98) now report that the Russians recently made their first flight test firing of a missile prototype aimed at achieving intercontinental range. This flight test occurred after a series of static test firings in which the missile was anchored to the ground while its various subsystems were checked.

The Convair Atlas, which is the first U. S. ICBM to reach the prototype stage, is now at the USAF Missile Test Center at Cape Canaveral, Fla., where the first flight test firing is scheduled shortly. The Atlas has been fired in static tests at a special facility near Convair's San Diego plant where prototype Atlas missiles are being built.

Two versions of a 1,500-mile intermediate range ballistic missile are also in the initial flight testing stage at Cape Canaveral. Both the Douglas Thor developed for USAF and the Redstone Jupiter developed for the Army have been test fired twice from Cape Canaveral in their experimental development programs. The Soviets have been test firing their 900-mile missile for about 18 months.

Blunt Nose Cone Work Detailed

Washington—Major breakthrough in the atmospheric re-entry problem for ballistic missiles was made five years ago in the laboratories of the National Advisory Committee for Aeronautics, NACA reported last week.

The discovery was that a blunt nose will reduce heat input and provide inherent stability to a missile re-entering the earth's atmosphere at a high rate of speed (AW June 25, 1956, p. 50). Since publication of the NACA research report in 1953, the blunt nose has been incorporated in all IRBM and ICBM designs.

Recognition of the achievement came with the award of the NACA Distinguished Service Medal to H. Julian Allen, chief of the high-speed research division of NACA's Ames Aeronautical Laboratory at Moffett Field, Calif.

The award was presented by NACA Chairman James H. Doolittle, who said Allen's "analysis and discovery contributed importantly to the solution of the re-entry problem of long-range ballistic missiles."

Contrary Concept

In his 1953 research report, declassified by NACA last month, Allen established a concept contrary to that of current missile designers, all of whom were working on the theory that a slender nose would insure highest possible performance.

"Blunt shapes," he said, "appear superior to slender shapes from the standpoint of having lower maximum convective heat-transfer rates in the region of the nose."

At the time, missile designs were pencil-like in appearance. At high speeds, the thin boundary layer of air surrounding a pointed nose resulted in temperatures of thousands of degrees Fahrenheit. All proposed solutions to this problem were complex and heavy.

One missile design, for example, demanded that the weapon carry more than a ton of water that would cool the nose through evaporation or "sweating." Other suggestions included the use of porous walls.

Re-Entry Forces

Allen's studies began with an analysis of the velocity and deceleration of missiles entering the earth's atmosphere at high supersonic speeds. He found that, in general, the gravity force is negligible compared to the aerodynamic drag force and that the trajectory is essentially a straight line during the period of intense heating.

The NACA expert found that if a missile is relatively light, and the ICBM falls in this class, it will withstand heat best if it has a blunt shape. On the other hand, if it is relatively heavy, a long, slender shape will be most efficient. Missiles of intermediate slenderness should be avoided.

Why Britain Wants Missiles?

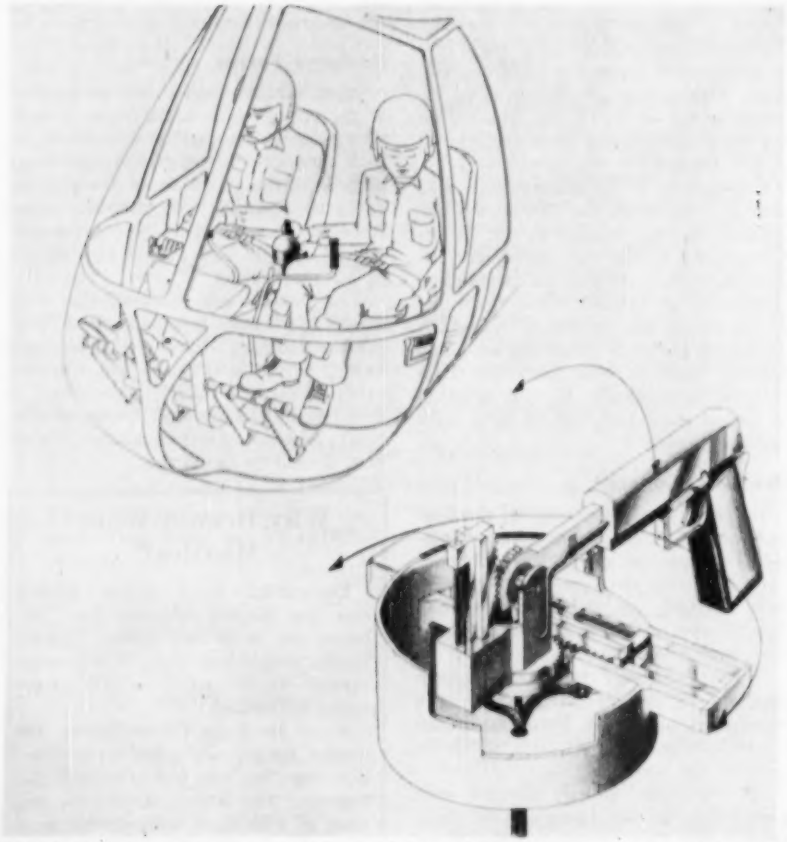
Unidentified flying objects sighted over the English Channel April 29 turned out to be two Hawker Hunter fighters from a large flight on a training exercise, Air Secretary George Ward revealed in London.

Royal Air Force Gloster Javelin all-weather fighters were scrambled to intercept them, but were unable to catch the Hunters. The Hunter, a subsonic airplane in level flight, is supersonic in a slight dive.

PROPOSED installation of fixed ground fire suppressor kits are on Kaman HOK-1 (top, left), Bell H-13 (left) and Hiller H-23 (right). Two kits can be mounted on each.

FLEXIBLE KITS are mounted on Sikorsky H-34 (top) and Vertol H-21 (bottom).

Firepower Pack Designed For Helicopter



OPERATING gun directors in cockpit provide for sideward, downward turret deflection.

Washington—Detachable machine gun turret and a rocket launcher designed as defensive armament for helicopters has been proposed to the military services by the new Missiles and Ordnance Systems Department of General Electric Co.

First of the new units, unveiled here at the 13th Annual National Forum of the American Helicopter Society, are these:

- **Fixed ground fire suppression kit.** Two can be carried on a small helicopter of the Bell 47 type, providing four 30-cal. machine guns and sixteen 3.5 in. rockets.
- **Flexible ground fire suppression** kit for larger, transport-type helicopters. One can be installed on each side of the fuselage, providing four 30-cal. machine guns. Weapons are fired from the cockpit and can be aimed through a hydraulically-operated turret.

Quick Installation

The kits can be installed or removed in less than five minutes without special tools.

They contain no electronic or other equipment that requires special maintenance.

GE spokesmen said the weapons are intended only for defensive fighting. One reason for this is the directive of Defense Secretary Charles E. Wilson confining Army's aviation to non-combative air support. The other is that experience of U.S. forces in Korea

TWO OTHER flexible mounts are shown on Kaman HOK and Sikorsky H-37 twin-engine helicopter.

and of the French in Algeria has shown the need for helicopter armament to suppress enemy ground fire. A possible future step, the spokesmen said, could be a launcher for the Dart anti-tank missile.

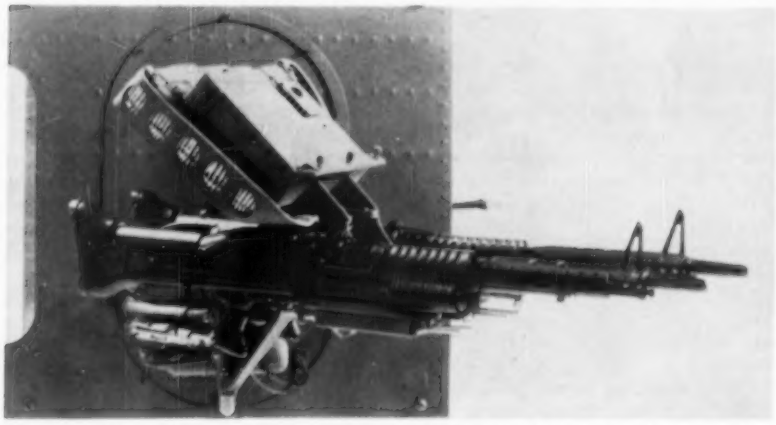
Both kits are light in weight and can be installed with a minimum of modification to the aircraft. Two of the fixed kits, including 1,200 rounds, 16 rockets and adaptors, weigh 435 lb. Two flexible kits, including 1,200 rounds, four guns and adaptors, weigh 395 lb.

Other Companies

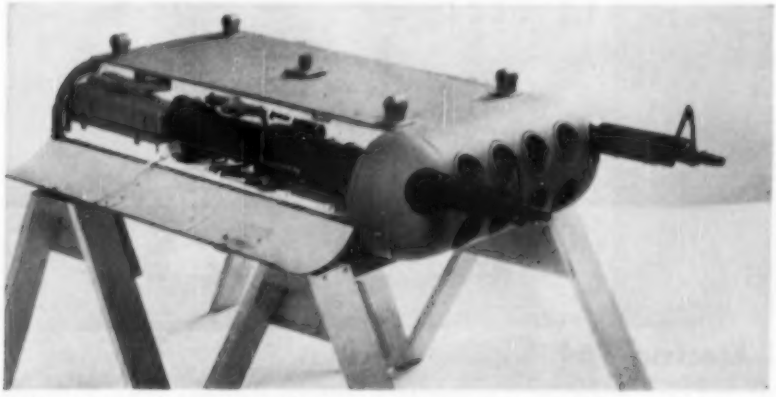
Several helicopter manufacturers are known to be working with the Army on the development of gun, rocket and missile installations for helicopters. The GE units, it was pointed out, will be universal in application and can be used on any rotary-wing aircraft, interchangeable from one to another.

Both ground fire suppression kits are designed so that assault troops, after landing, can remove the machine guns and ammunition from their mountings on the helicopter and use them as regular field weapons. No special tools are needed for maintenance or repairs.

In the case of the flexible machine gun mounting for transport helicopters, the ammunition is stored in the turret, not in the aircraft. The gun director is a pistol-grip control located between the pilot and co-pilot. The guns and turrets respond to movements of the director and return automatically to slow position when the grip is released.



TWO 30-CAL. machine guns are provided in flexible kit, 600 rounds of ammunition. Turrets are hydraulically operated, aimed from cockpit.



EIGHT 3.5 in. rockets and two 30-cal. machine guns can be carried in fixed kits. Two fixed kits can be carried on light helicopter.

USAF, Navy Report Unexpended Balance

Washington—Air Force and Navy had an unexpended balance of $19 billion on hand for aircraft and related procurement as of April 1. Of the total, USAF had $13.4 billion; Navy, $5.6 billion.

The unobligated balance on hand for new contracts totalled $7.5 billion—USAF, $5.4 billion; Navy, $2.1 billion.

During the first nine months of Fiscal 1957, the Air Force obligated a total of $6.1 billion for aircraft and related procurement as compared with $3.5 billion during the same Fiscal 1956 period. Navy obligated $1.7 billion as compared with $1.3 billion for the first nine months of Fiscal 1956.

Griffon II Flies On Ramjet Power Alone

Paris—Nord Co. has flown its Griffon II ramjet-turbojet interceptor for the first time on ramjet power only.

Griffon II took off from the French Air Force Test Center at Istres by using its Snecma Atar turbojet which is contained within the ramjet unit. Once proper altitude was reached, test pilot Andre Turcat cut in the aircraft's ramjet.

Griffon II is a delta-wing supersonic experimental airplane. The other French ramjet-turbojet experimental plane, the Leduc .022, has up to now flown only on its Atar jet. The Leduc aircraft is expected to begin ramjet operation shortly.

DO.27 Will Be Offered To Commercial Buyers

Bonn—The DO.27, a four-to-five-passenger plane with 270 hp., speed of 140 mph., and a range of 540 miles, will be available for civilian purchasers starting this fall, according to a statement by the manufacturer, Dornier-Werke, in Friedrichshafen.

Production now is fully taken up by the 400 planes ordered by the West German Defense Ministry.

Dornier-Werke claims the DO.27 has aroused strong interest among governmental authorities, airlines and companies all over the world.

Cordiner Fights For New Pay Proposal

By Claude Witze

Washington—Ralph J. Cordiner, president of General Electric Co., last week demanded an end to "politics as usual" in national defense.

Cordiner declared that the American people will support the recommendations of his Defense Advisory Committee on Professional and Technical Compensation once they understand the issues despite disapproval of the program by the Eisenhower Administration's Bureau of the Budget. The committee has proposed a new pay and manpower structure designed to retain for the armed services technical personnel whose training is both costly and slow.

Failure of the political leaders of both parties to seek this kind of public support, Cordiner declared, "would be a shameful evasion of responsibility."

Cordiner spoke before the eighth annual National Armed Forces Day Dinner in Washington less than two weeks after the Budget Bureau turned down his plan designed to save $5 billion a year and improve U. S. combat capability with the charge that it is "inflationary."

Defense Department's own compromise with the Cordiner recommendations, forced on it by the Budget Bureau's attitude, is a proposal to provide pay raises of $12 to $50 a month for enlisted men with special skills.

Commenting on this idea, Cordiner told his dinner audience there will be no significant improvements gained from "bits and pieces of the recommended program, or by attempting to retain outstanding personnel with watered-down incentives.

"The committee," he asserted, "stands four-square behind its complete balanced program which was carefully designed to produce positive and long-lasting results."

In a restrained rebuttal of the Administration's viewpoint, Cordiner said Defense Department has a difficult job in administering an activity that spends nearly $40 billion a year. There are enough problems, he said, in considering all the military and economic factors.

On top of this, he added, "the additional confusion of political demagoguery is a luxury that this country cannot afford."

On the subject of Defense Department manpower, Cordiner has made a year-and-a-half study, out of which came his committee's recommendations to improve the skill level of the armed forces and retain skilled personnel on the payroll.

He told his Armed Forces Day audience, most of it from the military services, some of the things he has learned about their jobs:

- **Re-enlistment rate** in the "common skills" such as truck drivers and cooks runs 25%, and the armed forces have more than enough personnel in this class, one that is easy and cheap to train.
- **Re-enlistment rate** among electronic and other technical skills is only 13%. The remaining 87% get out of uniform as fast as they can to enter private industry. Training for these skills is slow and costly.
- **Among junior officers,** 73% quit the armed forces after finishing their obligated tours of duty. In Fiscal 1955, this included 4,000 pilots whose training represented an investment of $480 million.

"The challenge to stay ahead of potential aggressors means staying ahead in quality of men as well as of equipment," Cordiner declared.

"The public has apparently assumed that advanced weapons alone will produce an adequate defense and deterrent to war," Cordiner said. "This is not true."

"Advanced weapons will be useless unless the armed services are enabled to make the investment in building the stable force of experienced, highly skilled officers and men that such weapons require.

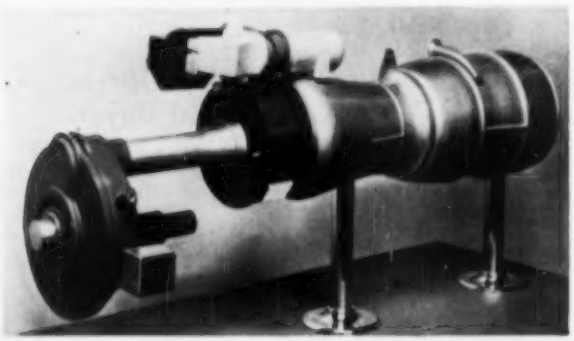
"I am confident that, when this issue has been brought constructively before the public, they will enthusiastically support legislation that will simultaneously strengthen the national security, reduce the cost of national defense, save the lives of their sons in training and combat, introduce greater justice into the pay system of the armed forces and ultimately reduce the number of citizens required to maintain the national defense."

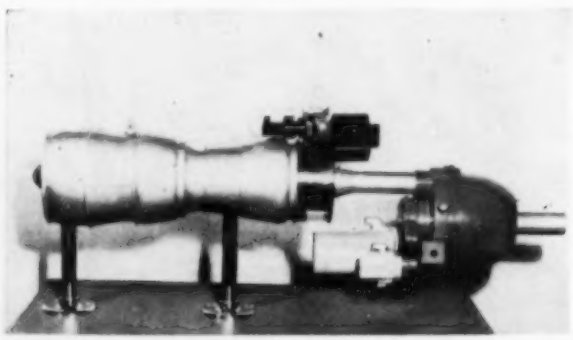
Defense Secretary Charles E. Wilson, accepting these arguments for the program, took steps to launch the program but his initial legislative proposal was turned down flat by the Budget Bureau (AW May 6, p. 25). Presumably the program would add to expenses for about two years, then result in substantial and lasting savings. The Defense Department did not ask for additional appropriations to meet the cost.

As chief of a leading Defense Department contractor, Cordiner did not hesitate to criticise some trends and policies in procurement that he feels are costly and unjustified.

He singled out these items for specific mention as signs that there is a temptation "to regard the defense budget as a huge WPA fund which can be used to make work in exchange for votes:"

- **Award of contracts** to firms in "depressed areas"—usually in communities





General Electric T64 Engine Mockup

T64 "convertible" gas turbine engine design (AW May 13, p. 26) recently was displayed to American Helicopter Society in form of model. Engine, scheduled to be built by General Electric Co. under Navy Bureau of Aeronautics contract, will have basic power section to which individual units can be added for operation as turboprop or turbojet power plant.

Widening mankind's horizon by conquering

WIDE OPEN SPACES

Men of vision, making the unknown known, have widened man's horizon—advanced civilization. From the great *sixteenth century* exploration of the earth, its oceans, lands and peoples, came knowledge now in everyday use. Today at **CONVAIR**-*Astronautics*, scientists and engineers have already embarked on the greatest challenge of the *twentieth century*—man's conquest of the uncharted, unknown and infinite universe. Knowledge gained from solving the mysteries of space will bring mankind untold benefits.

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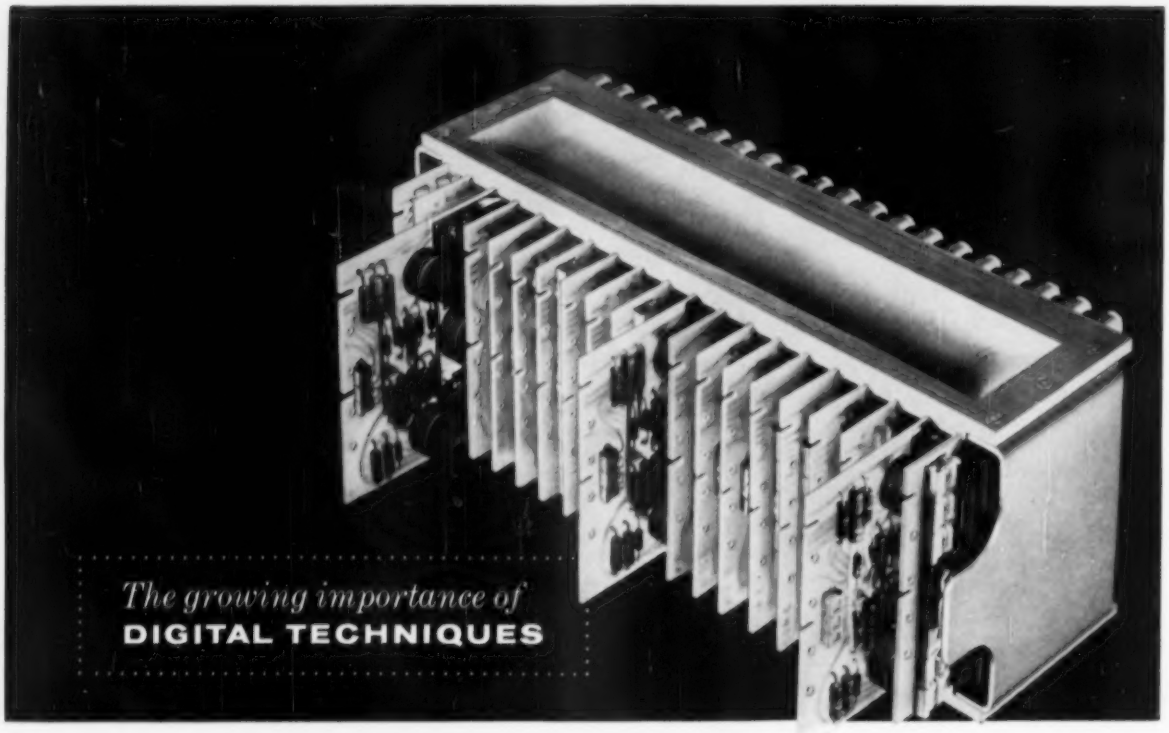
CONVAIR Astronautics, *is building a new facility at San Diego, California, which will be devoted to research, development, manufacturing and preliminary testing of the U.S. Air Force's Atlas Intercontinental Ballistic Missile, as well as other projects looking into the future of astronautics.*



As recently as ten years ago it was just becoming evident that digital techniques in electronics were destined to create a new and rapidly growing field. Today, incorporated in electronic computers and other equipment, they constitute one of the most significant developments in scientific computation, in electronic data processing for business and industry, and in electronic control systems for the military. In the near future they are expected to become a major new factor in industrial process control systems.

The digital computer for scientific computation is becoming commonplace in research and development laboratories. Such machines range from small specialized units costing a few thousand dollars, to large general purpose computers costing over a million dollars. One of these large computers is a part of the Ramo-Wooldridge Computing Center, and a second such unit will be installed the latter part of this year. The digital computer has not only lightened the computation load for scientists and engineers, but has made possible many calculations which previously were impracticable. Such computers have played a major role in the modern systems engineering approach to complex problems.

Electronic data processing for business and industry is now well under way, based on earlier developments in electronic computers. Data processors have much in common with computers, including the utilization of digital techniques. In this field, teams of Ramo-Wooldridge specialists are providing consulting services to a variety of clients on the application of data processing equipment to their problems.

The use of digital techniques in military control systems is an accomplished fact. Modern interceptor aircraft, for example, use digital fire control systems. A number of Ramo-Wooldridge scientists and engineers have pioneered in this field, and the photograph above shows a part of an R-W-developed airborne digital computer.

These, then, are some of the aspects of the rapid growth which is taking place in the field of digital techniques. Scientists and engineers with experience in this field are invited to explore openings at The Ramo-Wooldridge Corporation in:

Automation and Data Processing
Digital Computers and Control Systems
Airborne Electronic and Control Systems
Guided Missile Research and Development
Electronic Instrumentation and Test Equipment
Communication Systems

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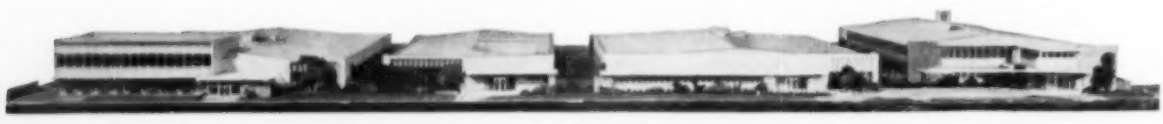


Long-Range Interceptor

Washington—Air Force announced last week that it has awarded a design study contract for a long-range interceptor to North American Aviation, Inc.

Original design competition for the interceptor was begun in 1955, but Air Force called a halt to the program when it looked as though its Fiscal 1957 research and development funds were going to be cut by Congress (AW May 21, 1956, p. 26).

A second design competition was inaugurated late last year. Both North American and Northrop were participating in the first competition before it was ordered to a halt.

Stipulated combat radius for the earlier interceptor, and presumably for the new one, was 1,500 miles.

where costs are generally out of line.

• **Award of contracts** to failing companies. "Let us keep politics and relief separate from defense."

• **Overemphasis** on the concentration of defense business in large firms with outstanding research and development facilities. Subcontracting usually is ignored when prime contract figures are quoted.

"Too Slow"

Cordiner included a strong plea for new incentives to keep business interested in defense contracting on a permanent instead of a "crash" basis.

The on-again, off-again system, he declared, is "incapable of keeping the nation abreast of technological advances in weapons systems.

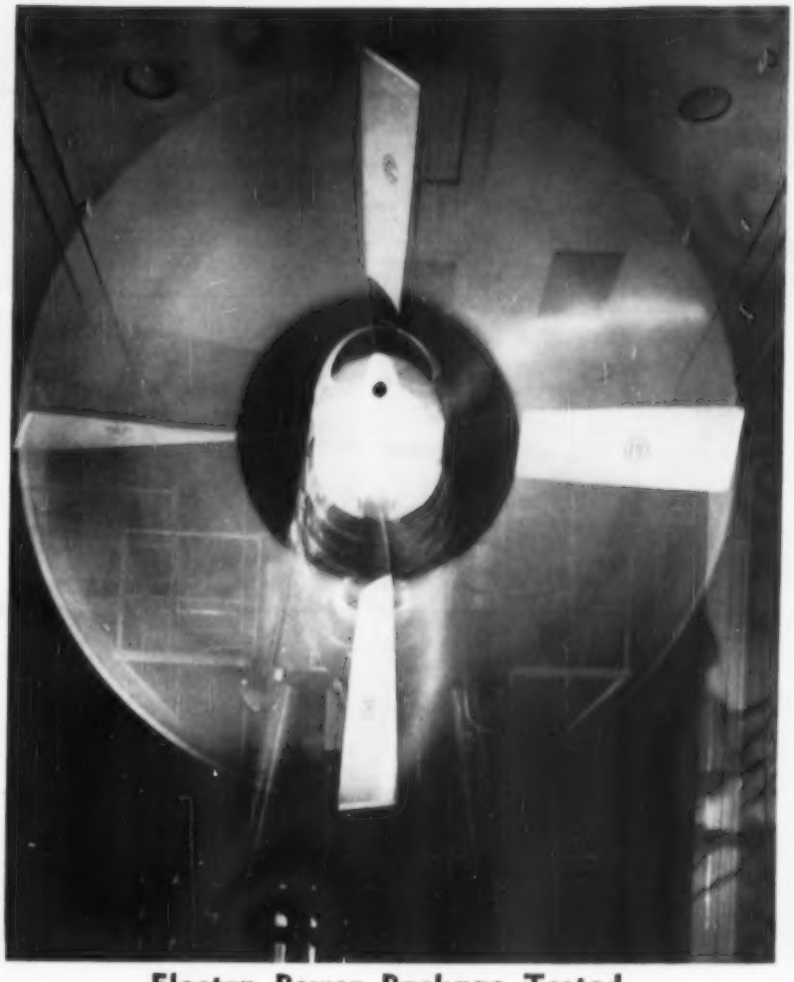
"Today, industry must be encouraged to devote manpower and resources to the task continuously, and to take the great technological risks that bring great advances.

Industry should have greater incentives to reduce costs, as it has in commercial business.

"In other words, defense should be conducted as a business instead of an interruption of business."

Holtoner Gets Transfer

Washington—Brig. Gen. J. Stanley Holtoner, head of USAF's Flight Test Center, Edwards AFB, Calif., since January, 1952, will be transferred early next month to the Third Air Force in Europe where he will serve as deputy commander. Gen. Holtoner will be replaced at Edwards by Brig. Gen. Marcus F. Cooper, now chief of the Air Force section of the mutual aid program in Turkey.



Electra Power Package Tested

Allison 501D turbine engine and Aeroproducts 606 propeller undergo ground testing at Allison facility in Indianapolis. Test, one of several simulated flight endurance trials, is equivalent of 1,000-hour commercial airline flight schedule in the Lockheed Electra turboprop. Double exposure was used in photo above to show size and arc of the large, blunt-tipped propeller blades.

News Digest

Douglas Thor IRBM rocket engines went into production at Neosho, Mo., plant of Rocketdyne Division, North American Aviation.

Cessna Aircraft Co. and Hertz Corp. began nation's first Rent-A-Plane service. Cessna 172, 182 and twin-engine 310 models will be available at 50 Hertz Rent-A-Plane stations at airports throughout the U.S.

Butler Aviation, fixed base operator at New York, Chicago, and Washington and Wheeler Air Lines, Canadian non-scheduled carrier, are latest Fairchild Friendship buyers. Each ordered one airplane.

Lockheed Aircraft Corp. could build a nuclear airplane within three years if given a go-ahead by the government and if "we could count on the supply of a propulsion system when we are ready for it," Lockheed Board Chairman Robert E. Gross said. Comment was made in connection with additional $4 million award from Air Force for Lockheed's Georgia Division work on a research and development laboratory for nuclear aircraft. Total allocation to the new Lockheed-Georgia facility now is $8.6 million.

British nuclear weapon was exploded last week from Vickers Valiant four-jet bomber near Christmas Island in the Pacific. Officially described as a "nuclear device," weapon was a hydrogen bomb, dropped by the Valiant at 45,000 ft. and exploded at 15,000 ft.

North Central Battles to Escape Subsidy

By L. L. Doty

Minneapolis—North Central Airlines is hinging its hopes for an escape from federal subsidy on new equipment and long-haul routes.

The decision by North Central to base its future on these two factors, probably will bring an order for Convair 440s and a strengthening of the carrier's bid for a wider region of operation and better routes.

During the past two years, North Central has held top place among all local service airlines in all categories of traffic with a program involving effective sales promotions, low operating costs and a commuter-type of high density flight schedules.

The airline now feels it has successfully proved that peak operating efficiency and rigid economics alone will not save local service carriers from the profitless dilemma the industry has faced since its inception ten years ago.

NORTH CENTRAL hopes to replace low-density DC-3s with more economical airplane.

North Central Formula

Here is North Central's formula:

• **New equipment.** High-cost, low-capacity DC-3s are a deterring factor in local service growth, according to North Central officials. The airline likes the Convair 440 and probably will order several if and when a long-haul route is granted. It admits, however, that the larger aircraft is not a final solution. Hal N. Carr, North Central president, says the 440 will economically serve only about 20% of the route structure the airline hopes to attain. Carr wants an aircraft similar to the proposed medium-range DC-10—the Douglas model 1940 (AW March 25, p. 38).

• **Long-haul routes.** North Central wants non-stop rights between Duluth and Chicago and between Minneapolis and Chicago. The airline argues that non-stop privileges will give it financial strength no other route modification can provide and will not interfere with the service it is now required to give intermediate points.

• **Widening of the region** it serves. Despite the recent Civil Aeronautics Board disapproval of the proposed merger with Lake Central Airlines, North Central will continue its aggressive campaign to add some 10,000 miles to its routes. North Central officials feel that applications pending before the Board for new routes, if approved, will give the airline a better chance to expand and develop traffic potentials.

Carr told AVIATION WEEK that high payload aircraft with low operating costs cannot serve his basic principle of successful local service operations—mass production flight schedules. He pointed out that on the Chicago-Milwaukee route, where North Central operates a total of 21 flights daily, two aircraft are scheduled to depart simultaneously in "trailer fashion" during peak hours in order to attain required seat capacity.

Equipment market surveys by Carr and his officers have proved to their satisfaction that no aircraft suitable to North Central's immediate requirements is available. Carr termed seat capacity of the F-27 too low for his theory of high-density flight operations and added that "any planes we might buy now would serve with the DC-3s as interim aircraft."

Carr, who at 36 is one of the youngest airline presidents, says he has no intention of trying to drop unproductive cities from the North Central system.

He believes the basic philosophy of local service operations must be retained by providing air service to cities off trunkline routes—"Our principle of frequent schedules at convenient times will often transform an unproductive traffic area to a profitable area."

ROUTES SHOWN make up present structure: North Central wants non-stop additions.

Long-Haul Support

Carr says North Central needs the support of long-haul routes within its region to realize profitable operations. He emphasizes his statement "within its region" by saying, "we want Chicago-Minneapolis non-stop rights but we are not invading the long-haul routes of trunkline carriers by asking for Chicago-Miami, for example."

Carr joined North Central Airlines in 1954 when the airline was on the

verge of bankruptcy. His triple-threat program of high-density schedules, economy and sales promotions was introduced immediately, and the airline began its rapid rise as a leading local service carrier with a profit of $111,000 in 1954 after a 1953 loss of $114,588.

Direct operating costs were cut to 33.6 cents per aircraft mile by 1955 as compared with a local service industry average of 34.62 cents. Flying operations costs declined to 29.79 cents in 1955 as compared with an industry average of 34.50 cents.

Passenger revenues have almost doubled, from $3.3 million in 1954 to $6.1 million in 1956, while the normal rise in operating expenses have been held to about 25%, or from $5.6 million in 1954 to $7.8 million last year.

Passenger Revenues

During the first quarter of 1957, passenger revenues reached $1.5 as compared with $1.2 million for the same period of 1956. Subsidy dropped from $415,000 to $344,928 and revenues from charter service jumped from $3,136 to $69,501 during the quarter.

North Central's success in reducing flying operations costs can be largely attributed to Alvin Niemeyer, vice president of operations, who was brought in by Carr to increase operational efficiency.

Economies

Some of the economies introduced by Niemeyer during his first year as head of operations:

• **Company policy required** off-airways flights to be cleared at each individual stop. By clearing each flight directly through to its destination, an estimated annual savings of $6,000 resulted.

• **Minimum en route altitudes** were revised, permitting VFR approaches under conditions previously calling for IFR operations. Estimated annual savings, $75,000.

• **Cross-wind component** of 15 mph. caused a number of station over-flies. Manual was revised to modify cross-wind component and to delegate decision to land under cross-wind conditions to the pilot. Approximate annual savings, $14,000.

• **Flight techniques** were developed to permit turns in the direction of the next stop following takeoffs. This replaced the standard practice of a long left turn before moving onto the en route course, a traffic-pattern procedure considered unnecessary by North Central in areas where air traffic is consistently at a minimum. Savings, $70,000.

• **Developed procedure** whereby commercial broadcasting stations are used to receive approach bearings to reduce minimums and prevent go-arounds. Savings at one station resulting from this procedure are estimated at $2,000 annually.

H. N. CARR

• **All manuals** except the Jeppeson manual carried and maintained by co-pilots have been eliminated from aircraft for a savings of 70 lb. per flight. Necessary flight manuals are maintained in libraries at each pilot base.

Pilots are under instructions to reach cruising altitudes as rapidly as possible and use straight-in approaches whenever practical to cut fuel costs. North Central's gasoline consumption as a direct result of this procedure averages a low 99.08 gallons per hour as compared with the DC-3 average of 106 gallons.

Utilization Rate

The airline reached a peak 8.43 hours utilization last June. It averaged 7.40 hours utilization for the year. Unscheduled engine changes during the year averaged one every 12,000 engine hours.

Engine overhaul is at 1,300 hours; aircraft overhaul recently has been approved at 12,500 hours. All engine overhaul is performed by Gopher Aviation, of Rochester, Minn.

Line maintenance is confined to the midnight shift so that the largest possible fleet can be kept in operation during peak traffic hours. Number one check is at 110 hours; number two at 210; number three at 400.

Frank Buttomer, vice president of traffic and sales, has sparked the successful sales promotion program which has helped give the airline essential identity in the region it serves.

Buttomer, who says North Central cannot yet afford national advertising, favors newspaper advertising in his overall promotional campaigns but rates direct mail programs as a close-second for effectiveness in getting his sales messages across. Through advertising trade agreements, he uses radio and television but is not always satisfied with the time and spots available under the arrangement which permits the exchange of transportation for advertising space.

'Indirect Competition'

With respect to long-haul routes, Buttomer stresses that long-haul routes are not always necessarily competitive with trunkline services. He calls such competition "indirect competition" and cites North Central's petition for Duluth-Chicago non-stop service as an example.

"Such a route," he says, "will obviously divert some traffic from Northwest Airlines because it will no longer be necessary to feed passengers from Duluth to Minneapolis via North Central to permit use of Northwest's non-stop Minneapolis-Chicago service."

During March, the airline operated 8,280,000 revenue passenger miles as compared with 5.6 million for the same month of 1956. Available seat miles rose from 11.6 million in March, 1956, to 17 million in March this year.

Load factor for the month was 48.69%, a slight drop from 48.9% last year. Percent of scheduled miles completed during March, 1957 was 97.9% compared with 91.97% last year. Average number of passengers per aircraft in March was 11.

At present, the airline has 999 employes, including 156 pilots and co-pilots, 212 maintenance personnel and 241 operations and traffic employes.

Cargo Lines to Receive Permanent Certificates

Washington — Senate has unanimously passed legislation directing the Civil Aeronautics Board to grant permanent certificates to certificated domestic all-cargo carriers.

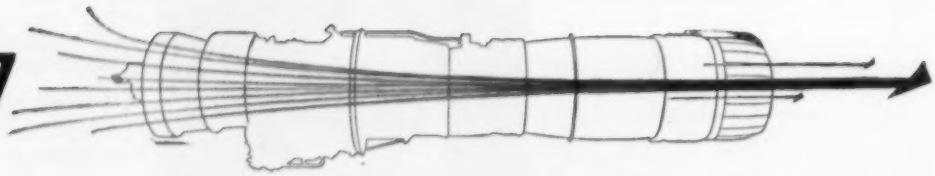
These are AAXICO (American Air Export-Import Co.), Flying Tiger Line, Riddle Airlines and Slick Airways.

Sen. Mike Monroney (D.-Okla.), chairman of the Senate Commerce Aviation Subcommittee, told the Senate that "the present record-breaking passenger traffic will seem rather small indeed by comparison when this cargo service has had the chance to grow as a permanent part of our aviation industry. . . . I feel that there is a market ready and waiting for full development and expansion of air freight. . . ."

The legislation is now up for House action.

Slick and Flying Tiger already had won a five-year renewal of their temporary operating authority in a CAB decision on the east-west portion of the airfreight renewal case (AW Feb. 25, p. 142).

J57



The J57 is a big bruiser!

This turbojet engine weighs more than 5,000 pounds, develops more than 15,000 pounds of thrust, has thousands of parts—one of the smallest of which, a fuel nozzle seal, you see here.

But what do these figures really say about the J57 we build? Do they say it was designed by Pratt & Whitney, a division of United Aircraft Company?

. . . that it takes complete cooperation among the designer, Air Force, and manufacturer to make certain every engine meets rigid performance standards.

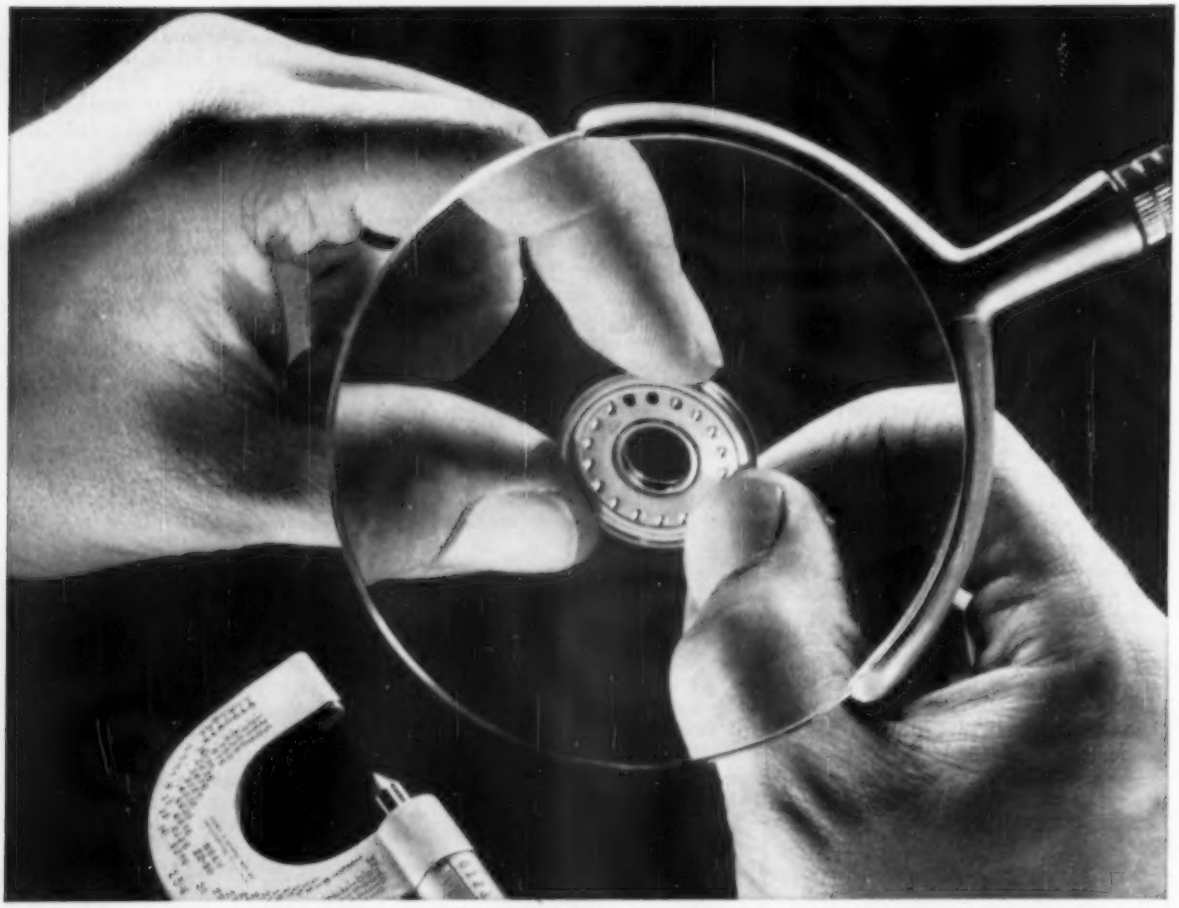
. . . that the J57 is used in some of the latest Air Force equipment: "century series" fighter models, B-52 intercontinental heavy bomber, and KC-135 tanker-transport.

. . . that it takes a vast network of parts suppliers reaching into 27 states to feed us the components we need to meet our schedules.

. . . that it takes teamwork *on every level* to establish and maintain quality volume production.

You can see cold statistics don't tell the full story. Unintentionally they miss this vital point: behind every completed engine lies a tremendous amount of cooperation and skill.

We believe the J57 jet engine is proof we've developed a high degree of both.



AIRCRAFT ENGINE DIVISION • FORD MOTOR COMPANY

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EIGHT new Viscount 700 series aircraft at Hurn include two for Linee Aeree Italiane. Four Capital airplanes are part of group of 15 which Capital has decided to defer delivery (AW May 13, p. 39). Vickers is seeking other buyers.

Italy to Merge, Demilitarize Airlines

Rome—Italy's two top airplanes, LAI and Alitalia, are to be merged into a single government-controlled and largely government-owned company in an effort to boost Italian commercial aviation to a competitive position with major world carriers.

Concurrently, the government is moving to transfer supervisory authority over operation of the nation's airlines from military to civilian hands. A law creating a High Commissioner for Civil Aviation with the rank of Undersecretary and responsible directly to the Prime Minister's office (Presidency of the Council of Ministers) was drafted for presentation to Parliament. Civil aviation has been controlled by the Ministry of Defense.

The LAI-Alitalia merger and the status of Italian civilian aviation have been the subject of a three-month study by an Inter-Ministerial Commission headed by Deputy Prime Minister Giuseppe Saragat, leader of the Social Democratic Party, whose advocacy of State Ownership and control of public utilities is well known. The Commission's bulky report and its recommendations for creating an Undersecretariat for Civil Aviation and for expediting the LAI-Alitalia merger are on Prime Minister Antonio Segni's desk.

Decision to merge the two lines came after a series of fatal mishaps to LAI planes, one at Idlewild in the winter of 1955 and two in rapid succession at Orly in November and on Mount Giner in December, 1956, and the disclosure of internal tensions and disagreements over operational and administrative methods within the company.

Two factors were held principally responsible for alleged LAI operational and administrative inefficiency: the financial structure of the company and military rather than civilian supervision.

LAI ownership was mixed. The Italian Reconstruction Institute, IRI, a state holding company for operating enterprises with mixed government and private capital, owned 40% of LAI's stock. Another 40% was held by Trans World Airlines. The remaining 20% was split. Franco Palma, successful manufacturer of pharmaceuticals (formerly a Squibb affiliate) held 10% and Fiat, Piaggio and Bastogi 10%.

Near the time that an LAI DC-3 crashed into Mount Giner, in the Italian Alps, TWA and Palma attempted to obtain stock control of LAI. Palma replaced General Luigi Gallo, former fighter pilot as general manager, bought 10 British Viscounts to replace all DC-3's and Convairs on the national and continental runs and talked of introducing jets on the transatlantic route to New York by 1960. Four 1649A Super Constellations were purchased, the first of which will be delivered within six months.

Gallo had based his operations on Douglas aircraft. He was a firm believer in what he called "uniformity of aircraft and maintenance procedures." The line's president, Barcantonio Pacelli, nephew of Pope Pius XII, favored Lockheed equipment. Board meetings became highly heated with the Gallo-Pacelli, Douglas-Lockheed controversy. The Mount Giner crash brought the antagonisms to a climax. Then Palma entered the picture.

Franco Palma, former pilot, American trained administrator and executive, bought into the company with an investment of $1,000,000 and assumed the general managership in the hope that, joining forces with TWA, he would be able to put the line on a sound operational and administrative basis. But the TWA-Palma team could not obtain control. Between them TWA and Palma held only 50% of the stock.

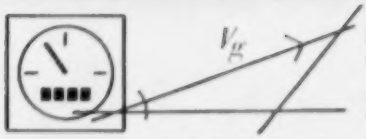
IRI meanwhile quietly bought out Fiat, Piaggio and Bastogi (exchange board name of Ferrovie Meridionale, a South Italy tram and trolley system) and moved in 58-year-old former Chief of Staff of the Italian Air Force, General Aldo Urbani, as president. Palma resigned, sold his stock to IRI and was replaced by another IRI man as general manager, Signor Zuccoli.

IRI is now in full control of LAI, owning 60% of the company's stock. TWA's holdings, it is understood, are for sale (AW Mar. 18, p. 43). If no private purchaser is found, the shares will be taken by IRI and LAI will be fully government owned.

There is no intention, however, of keeping LAI alive. The line will be gradually absorbed by Alitalia, which has had a perfect flying record with American planes. Its only accident, back in 1948, involved an old trimotored wartime Savoia-Marchetti wooden fuselage plane whose explosion in mid-air was believed to have resulted from an act of sabotage by Arab terrorists. The plane was carrying Jewish refugees to Israel on charter.

Alitalia is affiliated with British BEA/BOAC which owns 35% of the company's stock. IRI owns 65%.

Like LAI, Alitalia was originally



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oriented to Douglas planes, flying DC-6's and DC-6Bs on its South American and African routes. It uses Convairs on its European runs. Alitalia's President Velani is a firm believer in what he calls "homogeneity of equipment," wants an airline that operates "on two or three proved types and not half a dozen different planes that present all sorts of difficulties in maintenance and operations."

Liquidation of LAI will probably take at least a year and perhaps two or three years. It may prove to be a slow process whereby Alitalia gradually assumes the dimensions of a major competitor of established international carriers as Air France, Sabena and SAS.

There is no indication at this writing that BEA/BOAC intend to sell their Alitalia holdings.

The new line, when it emerges, will probably have a new name. Alitalia was established during the Fascist regime. LAI was a postwar, reconstruction-period creation, celebrating its tenth anniversary this month. Both lines were in the black when the reorganization started.

General Urbani's orders as president of LAI are explicit: liquidate LAI as quickly, rationally and economically as possible, making available its best personnel and equipment for merging with Alitalia. He has no written orders to that effect, but his mission is clear to everyone on the inside of Italy's presently confused civil aviation picture.

LAI has had, of course, the more difficult of the tasks fulfilled by the two airlines. While Alitalia flew the "good weather," fog-free routes to South America and Africa, LAI had the internal runs to Milan, Naples, Palermo and Cagliari, and the difficult North Atlantic route to New York. Italy is not the world's easiest flying country.

Milan, for instance, is fog-bound much of the year, its airport lying on the flat Po Valley between the towering Alps and the Appenines.

Just how many of LAI's estimated 1,500 pilots, technicians and other employes would eventually be absorbed by LAI was not clear. It was known, however, that Alitalia was being very choosy in selecting personnel and that it intended to take only the best in air and ground crews and equipment.

ALPA Will Pay Dues Dividend to Members

Air Line Pilots Assn. will divide $314,000 among its members this year as cash dividends on dues paid. Dividend amounts to 17% of each pilot's payments, the association said. ALPA has constitutional net worth limit of $2.5 million or $275 per active member, whichever is greater.

ATA Asks Congress to Curb Passenger Operations of MATS

Washington—Air Transport Assn. is asking Congress to specify in Fiscal 1958 Defense Department appropriations that 40% of military Air Transport Service's normal passenger traffic and 20% of its cargo must be transferred to commercial airlines.

Testifying before the House Appropriations Committee, Stuart G. Tipton, ATA president, said civil carriers should be the bulk haulers in providing routine transport service for the military. Airline equipment and facilities, he said, should be in constant readiness to perform "a major portion of the massive air transportation tasks that would have to be done in wartime."

MATS Role

Tipton told the committee that MATS should become a true "nucleus military air transportation system" engaged in "developing new techniques and equipment and in specialized military transport tasks that cannot be performed by the civil air carriers."

He said by the end of 1957, available capacity of the civil air reserve fleet will be sufficient to move 699,400 troops across the Atlantic during the first 30 days of any war action.

By 1961, he said, capacity will be great enough to move 1,083,000 troops the same distance in the same 30-day period.

Ralph Cox, J., president of the Air Coach Transport Assn., recommended a cut of $120 million in the Defense Department transportation budget and charged that congressional directives to use commercial transportation to the fullest extent possible have been "very largely ignored in the Pentagon."

Cox called for an "end of the Pentagon war against small independent enterprise" and urged that the military be required to "remove its arbitrary restrictions against full utilization of the equipment of supplemental air carriers."

Offer First

Francis J. Roach, general manager of the Independent Military Air Transport Assn., told the committee that MATS should not compete with civil air carriers and asked for a Defense Department directive that would require Defense to offer non-military traffic to commercial carriers before considering MATS.

Earlier, committee chairman George Mahon (D.-Tex.) warned that there is a "possible business plum here for private air transportation" which could run in "excess of $250 million." He added: "I want to do anything we can for the commercial airlines, but I do not want to sacrifice the interest of national security for private enterprise or anyone else."

USAF Rebuttal

Air Force Under Secretary James H. Douglas said the Air Force needs airlift from both military and civil segments but warned that, "in considering this question, it is appropriate to emphasize again there must be ready lift by military planes and crews. This can never be replaced by civil lift."

Douglas said in the peacetime division between passenger and cargo traffic, MATS will be used principally, but not exclusively, for cargo traffic, while civil carriers will be used primarily for passenger traffic.

He told the committee that a "hard-core" airlift, directly subject to military orders, in being and ready to support combat operations, is a "foremost consideration" of the Air Force. He said the need for a strong "backbone of military air transportation" necessitates continuous exercising of MATS fleets and manpower on its worldwide routes.

MATS is neither larger nor does it operate at a higher utilization in peacetime than it must have to carry out its wartime mission, Douglas told the committee. He added: "We have made no attempt to program MATS in peacetime at a utilization rate which would be competitive with normal commercial practice."

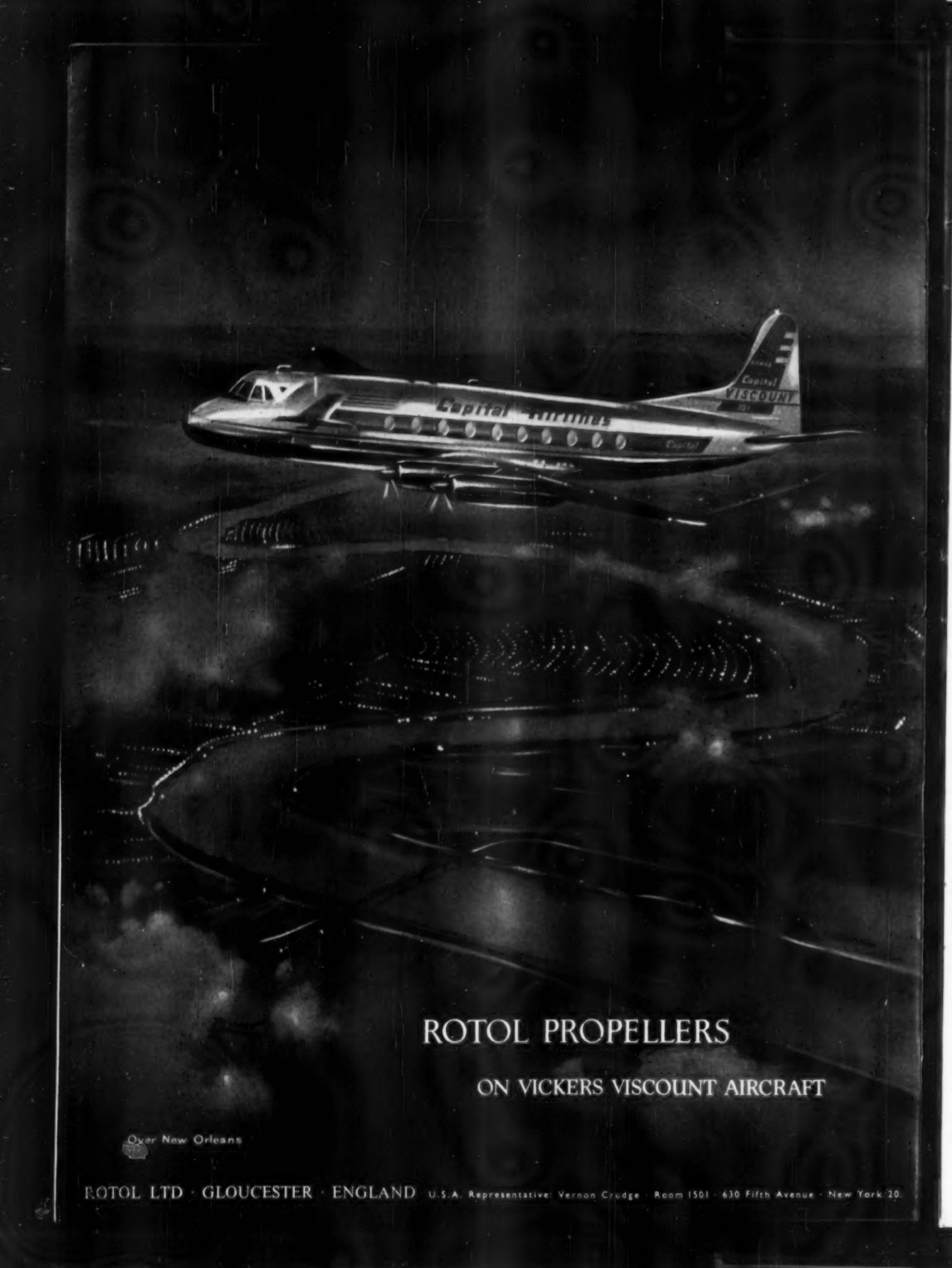
'Element of Uncertainty'

Douglas said it is "undeniable that there is an element of uncertainty with civil crews that does not exist to the same extent with military crews" and he added: "the fact is that civil crews do not have to fly if they do not want to."

Douglas pointed out that the MATS fleet as of Jan. 1 included 619 aircraft. That figure includes 116 C-124s belonging to the Tactical Air Command. Douglas said it is planned to eliminate 43 C-54s from the MATS fleet during the current fiscal year.

Complaint about competition from MATS came last week from Carter L. Burgess, Trans World Airlines president, who said commercial carriers could solve a large part of their financial problem if government competition were reduced to "reasonable proportions."

The MATS operation grew from $481 million in 1954 to $800 million last year, Burgess said.



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Senate Group Allows $352 Million for CAA

Washington—Senate Appropriations Committee approved a $352 million Fiscal 1958 budget for Civil Aeronautics Administration—a $23.5 million increase over the allocation voted by the House but still $58.6 million below CAA requests. The figure is $106 million above the air agency's Fiscal 1957 budget.

The major cut made by Senate Appropriations Committee was $42 million for the establishment of air navigation facilities. CAA requested $175 million. The House approved $116 million; the Senate committee, $133 million. The committee concurred with the House recommendation that $21.5 million should be transferred from the Department of Defense budget to CAA for the purely military aspects of the Vortac common navigation system. The committee also agreed with the House that $15 million should be withheld for long-range radar because "this program should proceed at a slower rate than proposed to prevent possible duplication between the extensive radar network of the military and that of the CAA."

The Senate committee approved the Civil Aeronautics Board's full request of $5.7 million for Fiscal 1958 operations and administration. This is $1.1 million above CAB's Fiscal 1957 budget and $469,600 above the House allowance.

Funds for airline subsidies, however, were cut $1.5 million below the House allowance and $5.1 million below the CAB request. A total $37.2 million was approved by the Senate committee which said that this amount "will be adequate in view of the approval of fare increases approved for Hawaiian carriers and other factors tending to reduce air carrier subsidies".

The Senate committee voted only $25 million for federal matching funds for airport construction—$10 million less than CAA asked and $5 million less than the funds allocated by the House.

An allocation of $250,000 for continued maintenance of 77 intermediate landing fields—eliminated by the House—was also approved by the Senate group.

Emperor's Constellation

Haile Selassie, Emperor of Ethiopia, and Ethiopian Airlines will share this Lockheed Constellation 749. When not in use by the Emperor, private compartment in cabin will be converted to passenger space and the aircraft will be flown on the carrier's international routes between Athens, Cairo and Addis Ababa.

New Jersey Jet Site Proposed To Airlines

New York—Proposal that a 75,000-acre Jet-Age City be built in Burlington County, N. J., about 75 miles south of New York and 18 miles east of Philadelphia, was made to the Jet-Age Conference being held in New York.

An invitation was made by General Robert L. Copsey, chief of New Jersey's Civil Aeronautics Administration, and George M. Rogers, director of the Burlington County Planning Board, to airlines and airframe manufacturers attending the conference to participate with Burlington County in developing the site into a jet travel center.

Rogers said that the Burlington County Board of Chosen Freeholders has applied to the Federal Government for $300,000 for preliminary engineering studies for the airport's development.

Features of the Jet-Age City, which may ultimately cost about $100 million, include: three-mile long runways with 1½ mile approaches; a wide buffer zone belt surrounding the airport proper, which would be zoned for airport based and related industry, with private housing specifically excluded; appropriate passenger and freight terminals.

Helicopter shuttle service to New York and Philadelphia is contemplated, as is frequent plane service to Boston and Washington, D. C.

Conference at which the proposal was made was sponsored by the Air Transport Division, American Society of Civil Engineers.

DC-8 Plant Opened

Douglas Aircraft Co. has opened its new $20 million DC-8 manufacturing plant at Long Beach, Calif. Final assembly building is at left above, structures assembly building adjoins it. Total floor space of the two buildings is 1 million sq. ft.; building area covers 23 acres.

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SHORTLINES

► **Viacao Aerea Sao Paulo** has ordered five Vickers Viscount 810 turboprop transports with scheduled delivery beginning in the summer of 1958. This brings to 385 the total number of Viscounts sold.

► **United Air Lines** will inaugurate Douglas DC-7 air coach schedules between New York and Los Angeles on June 9. The new service is scheduled to make the transcontinental flight in seven hours, 45 minutes.

► **Trans World Airlines** will begin daily scheduled service on U. S. and international routes with Lockheed 1649 Constellations on June 1. Over the Atlantic, TWA will schedule daily nonstop flights from New York to London and Paris, continuing on to Frankfurt and Rome.

► **Shell Oil Co.** is the exclusive supplier of fuel for Sud Aviation Corp.'s Caravelle during the jet airliner's American tour (AW May 13, p. 41). Shell will supply approximately 120,000 gallons of jet fuels to the Caravelle at sixteen cities while the new French twin-jet aircraft is being demonstrated to airline firms.

► **Miami International Airport** has reported substantial increases in passengers, mail and cargo during the first quarter of 1957 over the corresponding 1956 period. Passengers for 1957 totaled 1,215,157, an increase of 105,486 over 1956. International passengers totaled 261,147 as compared with 241,531 in 1956. Mail poundage increased by 553,341 to 4,011,409, and cargo weighed in at 49,143,335 lb., 8,463,100 lb. over the 1956 quarter.

► **Iberia Air Lines of Spain** will continue its Tuesday flight from New York to Madrid through June. Iberia also plans to fly into Bogota, Colombia, from Caracas, Venezuela. The Tuesday flight to Madrid, which began May 7, was originally scheduled to end May 31.

Correction

Due to a typographical error in the listing of airline income and expenses for February (AW May 13, p. 51), American Airlines was shown to have a net operating income of $884,381 for the period. The figure actually represents the net operating loss after taxes. Braniff Airways had a net operating loss after taxes of $488,348 rather than a net operating income of the same figure as reported.

AIRLINE OBSERVER

► **Civil Aeronautics Administration will place more emphasis upon research and development. It has named Lucius W. Burton to a newly created post of Planning and Development Director to head the projected research program. Burton will work closely with CAA's Indianapolis Technical Development Center in directing research and development activities for air traffic control of jet transports, airport and runway design requirements for civil jet use, jet flight operations and aeromedical factors connected with high-performance aircraft.**

► Lake Central Airlines will issue $300,000 in new securities next month. Funds raised will be used to improve working capital position of the company. Overall financing program of Lake Central includes the purchase of new equipment in 1960 or 1961 at a cost of $18 million.

► **Slick Airways will lease 24 R2800-CB engines for its three new DC-6A air freighters under a five-year contract with Pioneer Aircraft Leasing Corp., a subsidiary of Pacific Airmotive Corp. formed last November. Engines including the 12 spares will be delivered to Slick during the next 18 months.**

► Russian feederline officials are demanding more equipment to meet anticipated record passenger loads this summer. They point out that during the peak traffic season, many of their aircraft are assigned to crop dusting, causing a disruption of feeder schedules.

► **Chesapeake and Potomac Airways, newly formed helicopter line, will not seek a Civil Aeronautics Board certificate for scheduled service between Washington National Airport and Baltimore's Friendship Airport for at least another two years, according to a company spokesman. The company plans to operate industrial charter service between the two points with Bell 47Js to obtain operational experience. It feels that the Board will be more amenable to certificating a fourth helicopter airline after the three now in existence in New York, Chicago and Los Angeles become more firmly implanted in the overall air transport system.**

► East Lufthansa Airlines has announced summer schedules from East Berlin to Brussels, Paris, Copenhagen and Stockholm in addition to service to Moscow and other Iron Curtain cities. Since the airline does not operate into NATO countries, European observers believe schedules involve connections with the Polish Airline Lot and Czechoslovakian airline CSA at Prague to handle Paris and Brussels traffic. Flights to Copenhagen and Stockholm are probably scheduled with similar connections.

► **North Central Airlines attorneys will study the Civil Aeronautics Board Lake Central Airlines Acquisition Case decision when it is published in order to determine whether to take it to the U. S. Court of Appeals for the District of Columbia. CAB's announcement disapproving the proposed merger was issued in press release form and the final decision will be published later.**

► Resort Airlines certificate to operate all-expense air cruises to the Caribbean and other North and South American areas has been renewed by the Civil Aeronautics Board for a period of five years.

► **House anti-monopoly subcommittee headed by Rep. Emanuel Celler (D.-N. Y.) will issue its report on air transportation within the next two months. The subcommittee conducted extensive hearings last year looking for monopolistic practices within the air transport industry. Celler has indicated that he found monopolistic tendencies in the operation of the Air Transport Assn., the International Air Transport Assn. and the Air Coach Transport Assn.**

► Mohawk has contracted with Garrett Corp.'s AiResearch Aviation Service Division to modify five Convair 240s from a 40-passenger configuration to 46 seats. By moving front bulkhead forward, four seats facing aft will be installed in the front part of the cabin. Two seats will be placed in the aft section in the form of a divan separated from the main cabin by a bulkhead. Garrett will also install an integral stairway on the side of each plane.

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Airline Traffic — March, 1957

	Revenue Passengers	Revenue Passenger Miles (000)	Load Factor Per Cent	U. S. Mail	Express	Freight	Total Revenue Ton-Miles	Per Cent Revenue to Available Ton-Miles
DOMESTIC TRUNK								
American	621,298	401,876	62 9	1,729,746	829,919	6,729,693	47,989,801	57 0
Braniff	167,808	70,413	57 7	264,533	129,075	318,461	7,465,192	46 7
Capital	303,743	115,149	57 4	390,160	187,526	253,381	11,830,708	46 0
Continental	63,579	23,312	55 5	74,179	23,540	104,667	2,441,015	46 8
Delta	233,463	121,911	62 2	359,382	246,130	614,781	12,956,582	57 0
Eastern	714,800	442,180	62 82	981,976	480,450	1,281,582	45,495,659	45 69
National	156,853	111,400	63 4	353,368	69,600	529,632	11,794,373	53 2
Northeast	43,761	11,239	42 0	15,364	15,753	46,732	1,153,456	36 5
Northwest	100,325	64,886	54 1	373,746	215,578	745,570	7,565,379	48 1
Trans-World	344,849	255,071	57 4	1,090,336	754,162	2,169,768	28,517,718	52 2
United	472,260	339,596	61 0	2,368,311	925,219	3,956,854	39,873,892	53 1
Western	106,882	51,518	62 8	241,686	93,673	210,493	5,484,572	58 2
INTERNATIONAL								
American	13,288	10,260	72 4	12,191	437	349,981	1,454,800	73 1
Braniff	3,323	6,762	52 9	23,791	.....	72,376	840,660	55 7
Caribbean-Atlantic	22,148	1,593	55 70	1,361	.....	4,080	173,727	61 29
Delta	5,949	6,544	56 5	6,674	.....	74,546	807,830	51 1
Eastern	23,098	30,718	67 57	84,327	.....	87,560	3,346,783	56 54
National	7,692	5,361	49 7	9,978	5,467	30,099	608,159	49 8
Northwest	8,720	19,704	53 8	990,799	20,844	725,072	3,835,217	67 1
Pan American								
Alaska	4,496	5,047	47 0	36,884	.....	171,761	1,651,966	45 0
Atlantic	74,594	105,125	66 4	1,219,095	.....	2,236,206	14,613,639	63 8
Latin America	**115,931	100,582	65 2	382,818	.....	4,076,898	14,550,935	66 2
Pacific	23,197	94,843	77 9	1,034,015	.....	1,150,982	12,755,081	72 4
Panagra	12,273	16,582	66 0	64,552	.....	333,938	2,173,087	64 8
Trans-World	17,431	43,711	64 4	779,379	.....	799,306	6,227,266	69 5
United	6,796	17,474	61 2	84,434	.....	74,235	1,958,382	55 6
LOCAL SERVICE								
Allegheny	31,660	5,468	40 2	8,314	18,661	9,773	558,846	41 8
Bonanza	12,647	2,800	47 9	4,597	2,228	6,071	280,660	46 1
Central	8,878	1,709	29 4	4,307	2,409	7,242	179,527	26 7
Frontier	16,280	4,502	45 0	20,169	7,410	60,556	519,843	54 6
Lake Central	12,265	1,972	45 0	2,407	11,134	.....	202,003	40 4
Mohawk	.....	.....	.....	.....	.....	.....	.....	.....
North Central	52,141	8,281	48 5	20,589	27,090	.....	836,572	49 0
Ozark	30,055	4,711	39 0	11,316	15,827	7,700	484,891	40 7
Piedmont	30,608	6,154	50 5	12,660	10,206	10,661	623,179	50 2
Southern	17,524	3,117	47 2	8,649	10,975	.....	318,426	44 5
Southwest	24,922	5,361	51 4	9,069	4,399	6,126	530,506	49 8
Trans-Texas	21,451	4,814	37 1	14,446	8,296	21,952	503,655	37 2
West Coast	18,820	3,396	46 14	4,399	2,263	4,578	335,312	43 66
HAWAIIAN								
Hawaiian	29,892	4,567	56 9	3,726	.....	110,476	509,735	56 9
Trans-Pacific	11,656	1,698	52 5	1,076	.....	9,854	146,700	55 3
CARGO LINES								
Aerovias Sud-Americana	.....	.....	.....	.....	.....	873,867	873,867	83 1
Flying Tiger	4,427	25,350	99 7	39,941	52,805	7,678,863	10,306,542	82 5
Riddle****	.....	.....	.....	34,056	36,069	1,843,516	1,913,641	68 1
Seaboard-Western	1,557	9,438	100 0	.....	.....	1,481,693	2,431,499	73 7
Slick	6,014	22,225	93 11	85,771	79,756	4,692,558	7,080,571	70 28
HELICOPTER								
Chicago Helicopter	**1,752	28	38 9	2,568	.....	.....	2,568	48 4
Los Angeles Airways	**2,150	80	47 62	3,868	2,153	.....	13,876	59 09
New York Airways	4,799	89	34 6	***1,640	938	576	11,664	40 2
ALASKAN								
Alaska Airlines	241	375	13 7	17,983	.....	174,395	233,118	37 8
Alaska Coastal	3,225	290	61 0	3,879	.....	2,979	36,401	63 6
Cordova	1,392	412	53 6	2,779	.....	66,120	110,438	49 9
Ellis	3,332	221	49 4	1,444	.....	2,667	26,660	66 3
Pacific-Northern	6,098	5,484	40 8	65,159	.....	173,970	833,208	50 8

*Not Available.
**Number of revenue passenger enplanements.
***Mail transferred in bulk.
****Riddle domestic figures only.
Compiled by AVIATION WEEK from airline reports to the Civil Aeronautics Board.

SUPER CONSTELLATION load totaling 32,000 lb. goes aboard night flight at Idlewild. At right, specially-fitted DC-4 airlifts sheep.

Ocean Cargo Service Gains In First Year

By Glenn Garrison

New York—Seaboard and Western Airlines, encouraged by its first year as a scheduled transatlantic carrier, expects an 80% increase this year in its all-cargo commercial business.

Since it began scheduled service April 10, 1956, the airline has experienced a substantial growth in traffic as frequencies have risen and Super Constellation equipment has been phased into the operation to replace its DC-4s on the North Atlantic.

The airline earned $485,273 net after taxes on its overall 1956 operations, about a third of which were flown in commercial service. Profit was down from $1,967,369 in 1955, and the 1956 net included sale of a DC-4. But last year's costs included non-recurring items for expansion.

Revenues during the first quarter of 1957 totaled $4,836,749, up from $3,606,000 for the first quarter of last year. Net profit for the 1957 quarter totaled $158,711, S&W's best first quarter in the past five years. In the same quarter last year, its net was $5,676.

Only 10% of the first quarter 1957 revenues derived from Seaboard and Western's military contract business.

Shift from military contracts to commercial schedules as backbone of Seaboard's revenues will be accelerated this year, according to Arthur V. Norden, executive vice president and treasurer. Military work accounted for 65% of the carrier's 1956 business, Norden told AVIATION WEEK. This year's military work will be "substantially below 50%," Norden said. Eventual goal is to carry most of Seaboard's traffic in the scheduled cargo service. The commercial work provides the solid foundation for a common carrier, according to Norden.

Military business in 1956 consisted of Atlantic and Pacific airlifting of 6,266,000 ton-miles of freight and 57,000 personnel and dependents. Transatlantic commercial freight service for the year totaled 9,443,000 ton-miles, a 40% increase over 1955.

This commercial business amounted to 30% of Seaboard's 1956 traffic. Remaining 5% of the year's operating revenues derived from "wet lease" operations in which the airline provided planes, crews and maintenance under contracts with other carriers.

Seaboard and Western received its scheduled certificate in June, 1955. Inauguration of service was delayed until negotiations with other countries for operating rights had been completed.

After scheduled service started, it took a little time for shippers to begin using it, Norden said. As a result, momentum increased greatly near the year's end. Second quarter freight traffic was up only 19% over the same period of 1955, but third quarter business increased 34%, and the last quarter of 1956 showed a 116% gain.

This trend has continued in the early months of 1957. First quarter traffic was up 78% over last year. Load factor also has steadily increased. March, 1957 load factor on the scheduled Atlantic run was 73%, according to Norden.

Seaboard scheduled five DC-4 flights weekly during the initial phase of its operation. Schedules were increased to six last summer. Super Constellations replaced two of the DC-4 flights in November, and Monday through Friday Super Constellation service, plus a Saturday DC-4 flight, was scheduled last December.

Six 1049H Constellations, three of them owned by S&W and three operated under long term leases, were delivered to the airline last year. Four leased 1049Ds already were in operation, raising the Super Constellation fleet to ten aircraft. Balance of equipment now is four leased DC-4s and a S&W-owned C-46. Main use of the smaller planes is for shuttle service on the European side and for some transatlantic animal operations.

Seaboard has improved the performance of its older aircraft by technical modifications. Current gross takeoff weight of its DC-4s, the airline reports, is 73,800 lb. and transatlantic payload of the planes is between 18,000 and 19,000 lb. Changes included stripping of the planes to lighten them, better brakes.

The 1049D propellers were modified by installation of plastic trailing edge fairing and a change of hub spinner after body; wings were beefed up outboard of the outboard engines; bigger brakes were installed; side struts in land-

ing gear were changed; and drag strut damper was installed. These modifications, performed for the airline by Lockheed Aircraft Service-International, brought gross weight from 133,000 lb. to 135,400 lb.

Seaboard is further modifying the 1049Ds, doing its own work this time, to bring the gross up to 137,500, comparable to 1049H gross. Work includes substitution of Curtiss-Wright 972TC-18DA3 engines for DA1s; strengthening of nacelles; beefing of wing inboard of the outer splice; bigger oil lines; and a changed oil tank hopper.

New Facilities

To handle its expanded fleet, S&W has acquired new facilities at New York International Airport and now provides all its own maintenance except engine, propeller and component overhaul. Before 1955, all of the airline's maintenance was contracted; during 1955, Seaboard began handling work on its DC-4s, and last year the Lockheed planes were added. Half a hangar is now leased at Idlewild, comprising 65,000 sq. ft. of space, and there is 277,000 sq. ft. of paved ramp in addition. The maintenance staff now totals 255 people.

The airline has leased 12 acres at Idlewild for eventual construction of its own maintenance base.

Seaboard also has leased 12,000 sq. ft. of cargo space in the airport's new cargo terminal area.

Regarding future aircraft, Norden says the next plane for Seaboard is "three or four years down the pike."

Most important feature of a new cargo plane, according to the Seaboard official, will be ease of access in loading and unloading cargo. As tonnage capacity goes up, relative ground handling time must be cut or ton-mile costs won't come down enough to fill the planes, Norden believes. Cargo carriers now are forced to balance themselves on the end of a fork lift, according to Norden.

As an example of how ground times rise with capacity and cut into the utilization of more modern planes, Seaboard's DC-4s require about one and a half hours to load. Their transatlantic flight time is about 22 hr. eastbound, 26 hr. westbound. The Super Constellations cut flight time to 12 hr. eastbound, 14 hr. westbound—but loading time is about 3 hr., Norden said.

The Seaboard official won't quote ton-mile costs in his airline's operation, but he reports that the direct operating costs of its Constellations are about 70% of that of the DC-4s, where the utilization is constant.

Major S&W markets over the Atlantic include clothing, electronic equipment, machinery, pharmaceuticals, optical goods, aircraft and automotive parts, household furnishings. The airline has developed a palletized 5 x 5 x 7 ft. container for household goods, made of corrugated cardboard built around individual units of the shipments. Tubular cardboard legs of the containers permit easy fork lift handling.

There is a sharp difference between domestic and transatlantic cargo operations from a financial standpoint, according to Norden. Whereas the domestic carrier must keep its rates low enough to meet surface competition for many products, the transatlantic shipper will pay a much higher rate because of the relative lack of surface competition.

The overseas cargo operation therefore offers great profit potential for the carrier, Norden says.

Seaboard and Western is faced with the directional imbalance that plagues North Atlantic airlines, but Norden says the gap is narrowing. About 20% more of the airline's traffic now moves westbound than eastbound, according to the Seaboard official. He attributes the imbalance of air freight movement largely to the awareness of American importers of the advantages of using air.

Seasonal Slumps

Seaboard's seasonal slumps from a directional standpoint are inversely related to the passenger lines' situation, Norden points out. Other carriers' cargo space eastbound is limited during the summer when passenger loads are highest, hence this is a good season eastbound for S&W because plenty of shippers are looking for space. Westbound at this time, Seaboard's business is slower because eastbound passenger load factors are low and there is competitive space for cargo. Same relationship applies at other times of year, but Seaboard's growing share of the total business is illustrated, Norden says, by the fact that its January, 1957, eastbound loads were better than last year's peak during the fall.

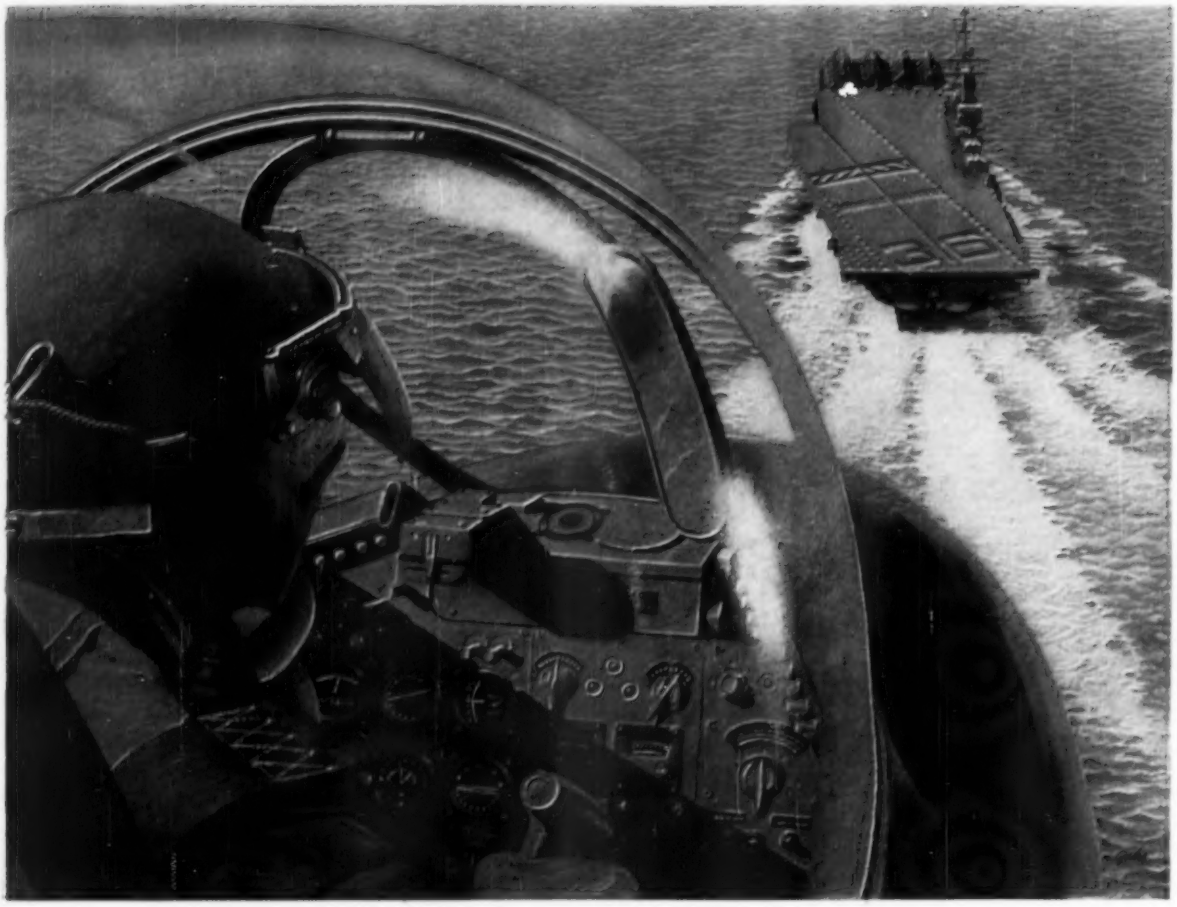
Those freight forwarders who act as the carrier's agent bring in a very substantial part of Seaboard's business, perhaps better than half, Norden reports. The forwarder who is simply a consolidator, not an agent, is a much lesser factor, bringing in less than 10% of the traffic.

Main problem from Seaboard's standpoint, Norden says, is to educate the public to air freight. If shippers could be sold to the extent that air passengers have been sold, the Seaboard official said, there would be plenty of business.

To further this end, Seaboard and Western has increased its sales staff by 50% during the past year and set up a program to indoctrinate its salesmen in the "basics of air transport economics."

Also during 1956, the airline appointed British Overseas Airways Corp. and Air France as its general sales agents in the United Kingdom and in France, the French Union and Mexico, respectively; appointed 300 new sales agents in this country and abroad; established an interline division to work with domestic carriers, and carried out a U.S. and foreign advertising program.

UNCRATED helicopters aboard Super Constellation are consigned to West German Army. The Bell rotocraft, destined for Dusseldorf, weighed 12,645 lb. total.



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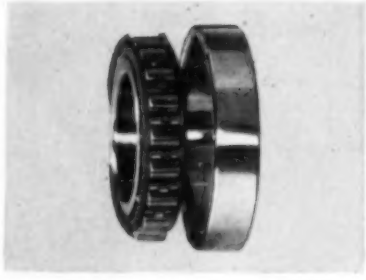

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Human Factors Stressed In Atlas Plant

By Irving Stone

San Diego—In contrast to a straight brick-and-mortar approach, human factors and environment are being emphasized in a new integrated facility being erected here adjacent to Montgomery Airport for development and manufacture of the Atlas intercontinental ballistic missile and advancement of practical space technology.

General Dynamics Corp.'s Convair-Astronautics Division is matching this facility to modern needs of close liaison in a growing complexity affecting research, engineering and production.

MANUFACTURING AREA of Astronautics plant will be housed in steel structure (rear). Laboratories will be in right foreground.

Construction Coordination

In a unique approach, Convair-Astronautics is coordinating the planning and construction of its requirements with one of its own engineers, George M. Robertson, who has valuable background in missile engineering and building construction. Now assistant chief engineer-administration and special assistant to J. R. Dempsey, division manager, Robertson formerly was chief engineer of Convair's Pomona guided missile plant, coordinated design and construction of that Navy-owned facility when it was built. Other construction experience includes aircraft plants, process plants and generating stations.

Architect-engineers for the Convair-Astronautics facility are Pereira & Luckman.

Main installations in the new facilities include:

- **Six-story** engineering building.
- **Six-story** administration building.
- **Reception center** connecting these two units.
- **Single-story** engineering and research laboratories complex.
- **Manufacturing** building.
- **Components-test** facilities.

In the layout of the overall facilities, special recognition has been given to the numerous internal and external interactions stemming from the extensive design and contractual relationships involved in the ICBM project. These relationships result from the urgency and complexity of the missile program and logistics associated with its operation.

There are hundreds of contractors and subcontractors involved, together with numerous government agencies. This creates a need for a large mockup area with means for demonstrating equipment and educating participant organizations in the particular phases of work being handled. This is one way Convair-Astronautics will provide a meeting place to facilitate the solution of design and coordination problems.

The large number of business visitors at Convair-Astronautics will have the convenience of putting decisions in motion quickly, even though they are away from home base. This will be accomplished by giving them the use of interview-office rooms with telephone service for rapid in-and-out communication. During technical conferences between business visitors and astronautics engineers, long distance calls will be able to be made on the spot to resolve difficulties, get answers to critical questions.

Room Locations

Interview rooms will be located on either side of the central entrance hall running between the engineering and administration buildings. Normally located outside the security area, they will be available to people without clearance, also will be available for limited use as private offices by contractors and government officials, and for interviewing prospective employes and vendors.

On the second floor of the central entrance, accessible to engineering and administration activities, will be a large conference room, fitted with the latest audio-visual presentation equipment to facilitate interchange of information in the missile program. One feature planned is closed-circuit TV as a means of observing plant operation remotely to ease resolution of problems between participating parties.

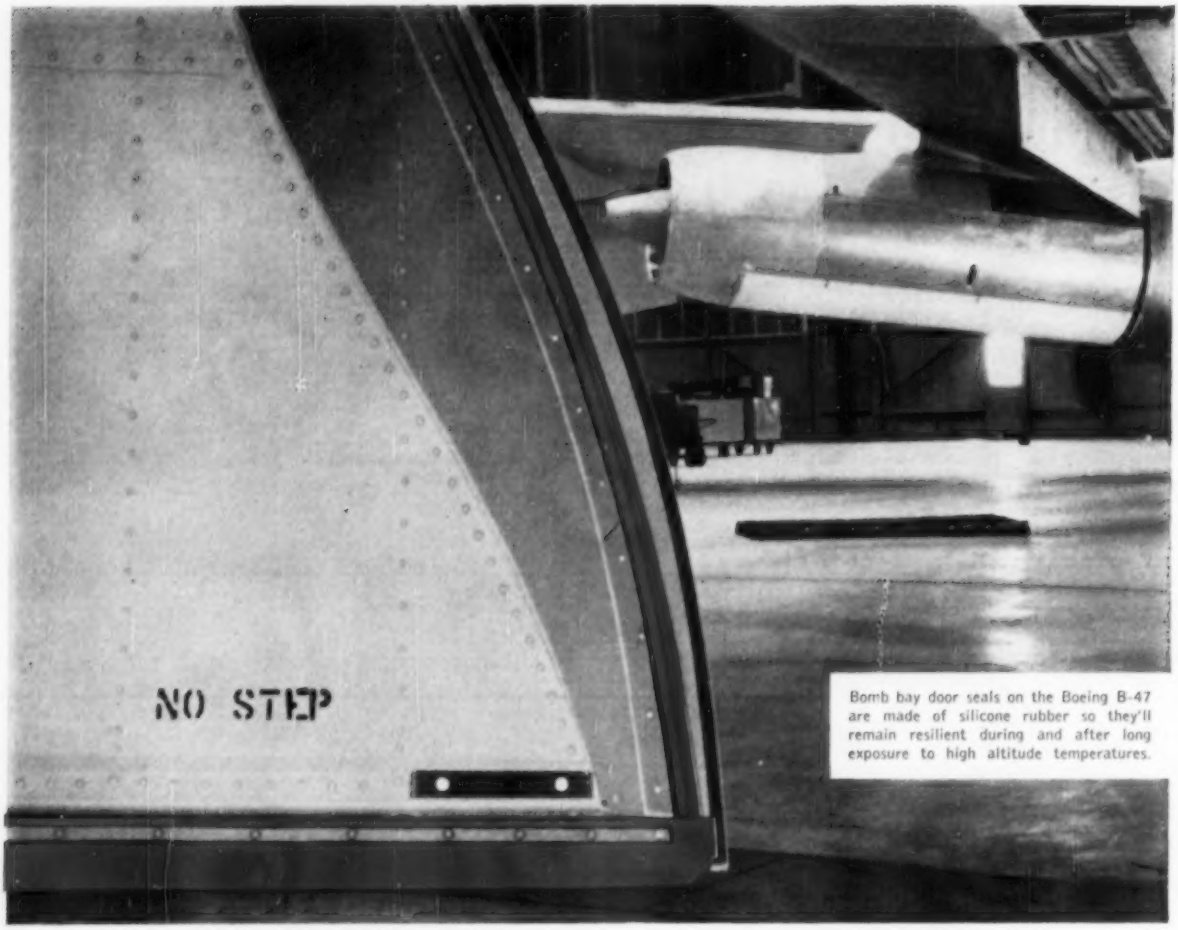
Time Saving

Conference room will have the usual accommodations for motion pictures, rear projection, lecture and demonstration facilities. To take care of a large number of conferees, provisions have been made for serving food, buffet style, saving time.

Convair-Astronautics has recognized the importance of professional society meetings in the continuing education of its engineers, and has specifically located the plant cafeteria with this in mind. Normally located in a security area, it obviates necessity for employes to go through gates for access to it during meal hours. By a minor rearrangement of gates, the cafeteria building can be made accessible to personnel without clearance, promoting its use for professional society meetings.

In the overall plan, Convair-Astronautics has compromised between the multi-story buildings normally used in cities and the rectangular single-story configuration which usually affords little window area per interior square foot.

A tower has been provided for the engineers to think and produce on paper, together with a "waffle-pattern"



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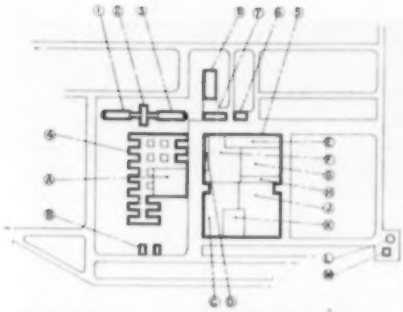

PLANT layout: (1) administration; (2) reception; (3) engineering; (4) engineering laboratories; (A) computer, data reduction and (B) centrifuge; (5) manufacturing, including (C) special services; (D) maintenance; (E) stores, shipping; (F) tooling; (G) fabrication; (H) process; (J) tank structure, assembly, checkout; (K) electronic manufacturing, test; (L) water tank; (M) hydropneumatic test stand; (6, 7, 8) security, cafeteria, etc.

layout on the ground for laboratory purposes, where equipment must be handled and moved around.

Both types of space are generously provided with windows. In the tower, measuring 75 x 225 ft., the entire periphery is made up of windows. In the waffle-pattern area, windows face on high-courts, 56 ft. square. The 75-ft. width of the tower building and the 56-ft. width of the waffle elements minimize the large "bullpen" effect so prevalent in many contemporary aircraft plants, tends to give the impression of more privacy for the engineer.

This general layout was motivated by dissatisfaction with World War II type of windowless cubes designed partially to withstand possible bomb blasts. In the Convair-Astronautics plant, since no above-ground structure is considered immune to bomb blast today, it was believed that engineers would prefer to work in a light, airy space.

In the waffle-pattern area will be housed laboratories devoted to electronics, environmental testing, reliability studies, trajectory instrumentation, component evaluations, gas dynamics, materials studies, inertial and magnetic components, computers, hydraulics, flight mechanics, autopilots and standards.

Floor space is saved in the individual waffle units by using court areas for corridors. Taking advantage of California weather, the design permits engineers to walk outdoors instead of using an inside hallway.

To insure conversion flexibility, provisions have been made to feed utilities to any area. In this way space devoted to paper work can be changed quickly to accommodate laboratory activities.

Also housed in the waffle-pattern area will be the newly formed Convair Scientific Research Group, a corporate activity, headed by Dr. Charles L. Critchfield. Generally concerned with problems which have to be solved to push frontiers ahead in missile and inhabited aircraft regimes, this group will have its own laboratory accommodations.

An important tool in the investigation of trajectory and dynamics problems is the computer center, which will include both digital and analog equipment. Total computer area will be almost 32,000 sq. ft.

Provisions have been made to simplify interconnection of computer units, and for switching underground ducts for greater cooling control of computers.

To make the overall plant as self sustaining as possible, supporting units, housed in separate buildings, include:

- **Combined** environment-velocity-acceleration testing unit for subjecting components to trials in simulated environments.
- **High flow** laboratory, principally for testing gas flow control components.
- **Radiation** systems-test.
- **Hydraulic** test laboratories.
- **Structures** test laboratories.

General manufacturing area is a single-story rectangular building covering approximately 540,000 sq. ft. in three bays. Between two main bays is a two-story area 60-ft. wide, housing factory

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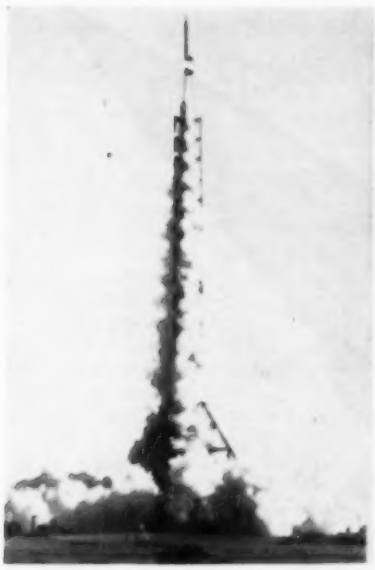

Aerobee Sets Record

Navy Aerobee-Hi starts flight to 190-mile altitude, a record for single-stage sounding rockets. Flight from White Sands Proving Ground, N. M. lasted about nine minutes, reached top speed of 4,900 mph.

offices, tool development laboratories, quality control laboratories, etc.

Large underground tunnels service the assembly and check-out areas because of peculiar problems involving special gases and cooling fluids. Various types of electrical power are also supplied.

The engineering building will be partially occupied by late June. Factory building is scheduled for operation by end of the year. Substantially everything used in pilot production of the missile, including hydrostatic test stand, will be moved from temporary quarters now used by Convair-Astronautics in Convair's San Diego Plant 1.

General Dynamics is putting about $20 million into land and buildings at the new site, with Air Force spending approximately the same amount for equipment for use in the division's activities.

Employment in Convair-Astronautics now totals about 6,000, with about 40% in technical and engineering activities. This figure is expected to rise to about 7,000 by spring 1958.

$21 Million For Navaho Awarded North American

North American Aviation has received additional $21 million for research and development work on Air Force's SM-64 Navaho intercontinental missile, currently under test in Florida. Company's Missile Development Division will get the funds.

(Advertisement)

Valve Talk

FOR WM. R. WHITTAKER CO., LTD.
BY MARVIN MILES

Whittaker's new customer service section is set up with two major objectives: To speed up re-work turnaround time, and to reduce re-work totals. By incorporating this section within its field engineering division, Whittaker will have also a clear record of the life of each and every unit from its production to the time the aircraft completes its final journey.

Jim Myatt, chief service engineer, has his sights set on 85 percent turnaround within a three-week period, and there's no doubt he'll achieve it—that's the way Jim works.

Previous to the recent organization of Myatt's new section, customer service was responsible only for the administration of re-work contracts and the associated paper work involved. The actual work was handled on any one of five regular production lines and thereby became secondary to production schedules.

Under the new setup, customer service has its own specialized re-work line with gate valve, butterfly, and actuator technicians, detailers, expediters, inspectors and a supervisor. Complete statistical records are maintained showing the types of re-work handled, analysis of responsibility, and the action taken to eliminate discrepancies. In the case of company responsibility, the proper Whittaker division is notified.

As you know, there are four general types of re-work: 1. Normal rejection for imperfections, assembly errors, design discrepancies—valves that are made good at Whittaker expense. 2. Units damaged by customer test, installation, or handling, wherein the customer bears the expense. 3. Re-work required by design or specification changes which can be charged to either Whittaker or the customer, depending on the nature of the changes. 4. Standard overhaul work.

Considering that Whittaker turns out between 120,000 and 140,000 valves a year, the normal rejection figure is exceedingly low. Take the 1956 record, for example. A total of 12,223 units went through customer service. Of these, 4,180 were put through re-work at Whittaker expense. Another 5,044 were repaired, adjusted or overhauled at customer expense, while 2,999 were overhauled or modified for the USAF at government expense. When any question of responsibility arises, it is Whittaker who assumes the expense.

Right now, one of Myatt's chief concerns is reducing the re-work ascribed to "normal rejection." In this endeavor his program includes a more stringent scrutiny of production assembly, a "detect and correct at source" policy.

Another facet which is going through the streamlining process is the standard overhaul work which represents about 40 percent of the customer service activity. This includes overhaul for both prime contractors and the Air Force with its eight busy maintenance centers that let overhaul and IRAN contracts. Engine valves are particularly critical, with Whittaker required to figure shipping time as well as overhaul time within a thirty-day deadline.

Among other responsibilities of this field engineering section are field service, spares provisioning, and publications.

Myatt, Jack Kelty and Frank Cockings take care of field service with constant visits to military installations to help iron out problems and with attendance at provisioning conferences to smooth out the spares situation.

Speaking of spares, Whittaker was one of the original suppliers to work out the kit concept that has been so successful in eliminating involved inventories by supplying needed parts in kit form rather than separately. Items for the PPB (provisioning parts breakdown) list are supplied automatically by the company as customer service determines the varying requirements.

In the publications field, Whittaker supplies the military and the primes with maintenance data on each item, together with overhaul manuals, for which the company is paid—material that is prepared by customer service as required.

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Boeing Plans Student Engineering Program

Boeing Airplane Co. has leased a building near the University of Washington campus in Seattle for a program to utilize university engineering students for nonclassified drafting work.

After their freshman year, engineering students will be hired on a part-time basis and paid on a sliding scale. "Farming out" of some routine work will enable company engineers to devote more of their time to the technical phases of their profession, Boeing said. Engineering students will gain experience and jobs to help defray their school expenses.

Boeing previously has made use of engineering students, but the students always were required to work in existing company facilities, some distance from the campus. The jobs are made more attractive by the new location just off the campus.

Boeing is establishing the same program at Seattle University, where 5,000 sq. ft. of space has been provided in the men's dormitory.

The University of Washington building has about 6,000 sq. ft. of floor space.

De Havilland to Build Near Vancouver Airport

De Havilland Aircraft of Canada Ltd., Toronto, Ont., plans to build a west coast factory on a 100 acre site near Vancouver, British Columbia. This forms part of a long range plan and no definite date has been set for this project. The land will be close to the Vancouver International Airport on Sea Island. It will replace a similar site purchased some years ago, which has been expropriated by the Canadian Department of Transport for expansion of Vancouver airport runways. De Havilland also has a parts and service office at Edmonton, Alberta.

B-47 Demonstrates LABS Bombing Run

Boeing B-47 Stratojet is capable of executing the half loop type of maneuver necessary to complete a LABS (Low Altitude Bombing System) run. In a firepower demonstration at Eglin AFB, a B-47 supplied with Minneapolis-Honeywell LABS equipment, the six-jet medium bomber performed bomb delivery maneuvers similar to those used by the fighter-bombers for which the system was originally developed.

Honeywell said it has received an Air Materiel Command contract for more than $1 million for the B-47 LABS equipment.

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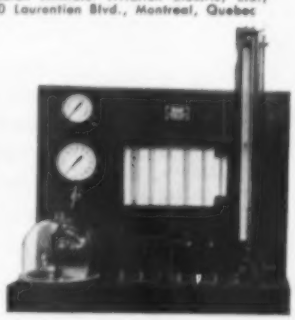
*Left to right—Bendix Type 31T8-1661 Liquid Oxygen Converter Build-up, Flow and Heat Loss Test Stand; Bendix Type 31T8-1663 Liquid Oxygen Converter Capacitance Type Contents Gage Test Stand, and Bendix Type 31T8-1662 Liquid Oxygen Converter Components and Accessories Test Stand.

←Bendix Type 31TA-1480 Oxygen Regulator Service Test Stand Auxiliary

Bendix Type 31TA-1479 Oxygen Regulator Service Test Calibration Stand→



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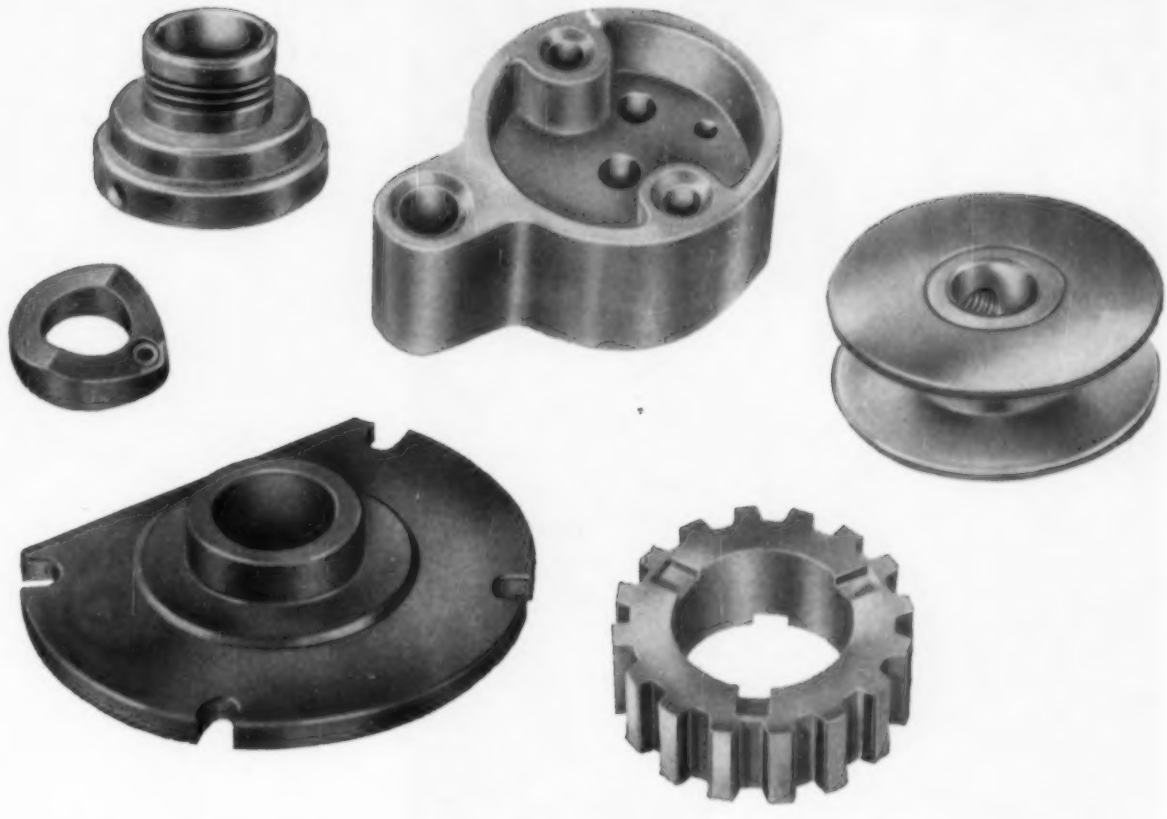

machine parts can be made design requirements . . .

ENGINEERING BULLETIN No. 19

Product engineers specifying materials will find a wealth of design information in this GRAMIX Machine Parts Bulletin. This material is presented in such concise form that questions are quickly and easily answered. A simple chart indicates which alloys—ferrous and non-ferrous—are suitable for different operating requirements. Working sketches show the various design possibilities—radii, helical teeth, dead-end holes, flanges, multiple shoulders—and how they can be utilized to best advantage. Physical properties are presented, and metallography discussed. In all, you'll find Bulletin 19 an ideally simplified guide to a complex subject . . . write now for your copy. 118

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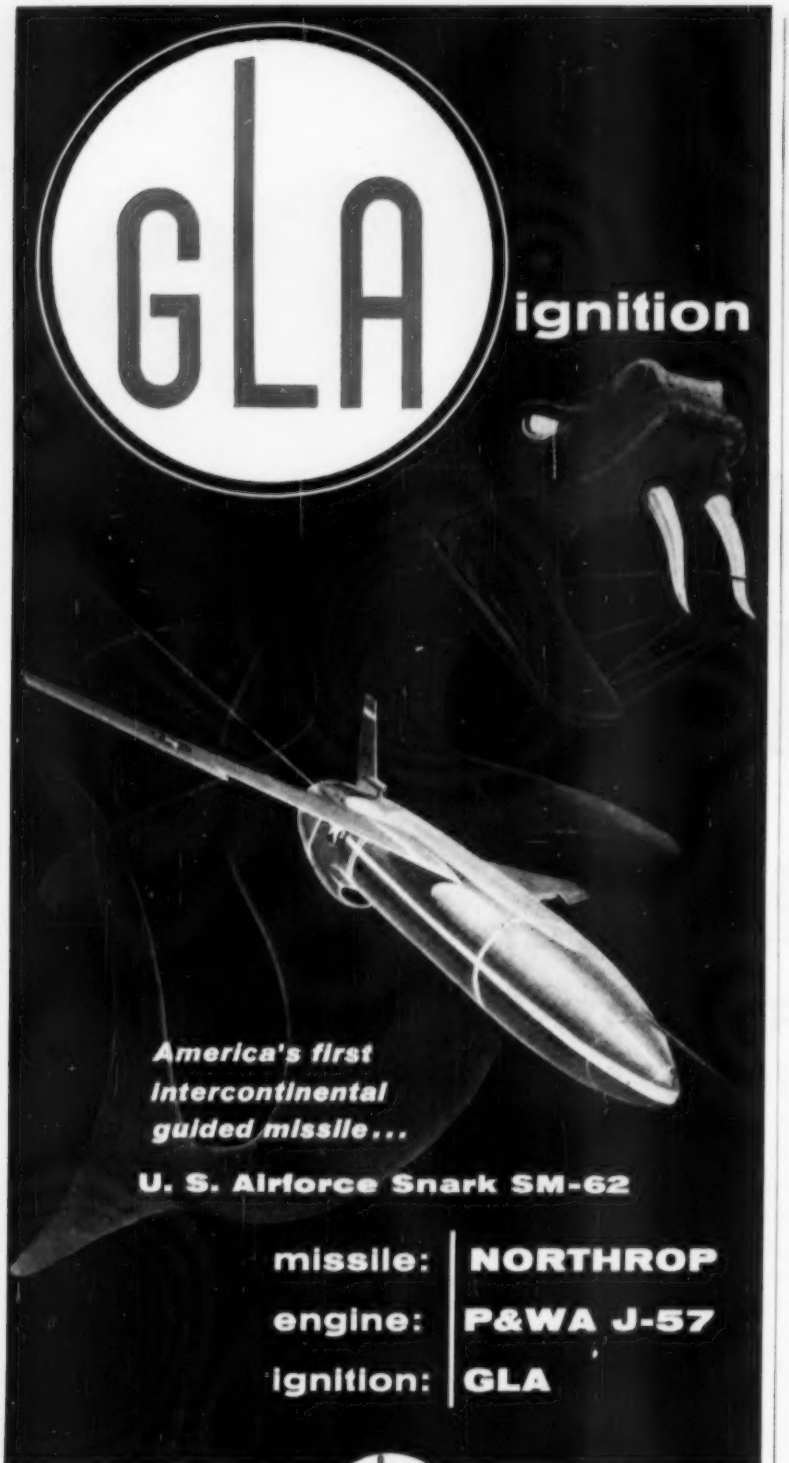

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RCAF Pilots Train for Comet Release

Royal Canadian Air Force has sent nine pilots to Hatfield, England, for a three month training course in de Havilland Comet jet aircraft. By midsummer 70 RCAF personnel will have taken the Comet training course.

The RCAF had two Comets which were grounded some time ago and then shipped to England for overhaul and changes resulting from experimental work done to determine causes of accidents to these aircraft. These aircraft are now nearing readiness for acceptance trials by the RCAF and the Canadian crews will fly the aircraft back to Canada on completion of their training.

MiG-19s Added to East Zone Air Force

Bonn—East German air force of approximately 10,000 men is now equipped with Soviet MiG-19 jet fighters. The MiG-19 has supersonic speed and can be compared with the North American F-100 jet fighters stationed in the Federal Republic.

Last year the air forces of the Soviet zone had only propeller training planes and about 35 MiG-15 jet fighters.

North American Options 12,600 Acres In Nevada

North American Aviation, Inc., has acquired options to purchase approximately 12,600 acres of land in Washoe Co., Nevada. Decision to purchase will not be made for some months. Location is being considered among others because of expansion possibilities for future development of manufacturing and test facilities, possibly in the electromechanical and rocket engine fields.

Surveys are to be undertaken to determine suitability of the terrain to NAA's diversified operations as well as potential labor supply and the availability of water, electrical power and other utilities and services.

Medium-Class Copter Developed by Russia

Bonn—German sources report Russia has developed a new helicopter similar in class to the Bell 47 or Cessna CH-1 types. Specifications for the Russian ship:

- **Engine**—260 hp. AI14.
- **Empty weight**—1,785 lb.
- **Gross weight**—2,864 lb.
- **Maximum speed**—93 mph.; cruising speed—71 mph.
- **Range**—214 mi.
- **Service ceiling**—13,779 ft.

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X-13
VERTIJET
RYAN

Vertijet Takes Off

Ryan's X-13 Vertijet test flight (AW May 13, p. 29) begins from raised trailer bed (left). Experimental plane disengages its hook from cable, moves away on vertical exhaust of its Rolls-Royce Avon engine (above), rotates away from trailer (above, right), climbs and starts conversion to level flight (below, right). For picture of design team, see next page.

VERTIJET'S NOSE appears in closeup above with plane hooked on and trailer bed lowered to horizontal position after landing. Ground service trailer is used for takeoff and landing, ground mobility. Note test boom vanes.

*The first successful interception of an aircraft by a guided missile was achieved by the Lark—equipped with a Raytheon guidance system.

Today Raytheon is the prime contractor for the Navy's Sparrow III and the Army's Hawk missiles.

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X-13 ENGINEERS include (left to right) Bruce Smith, vice president, engineering and military relations; William T. Immenschuh, chief of test operations; Charles Ackerman, project engineer.

Reactors Developed By North American

Research reactor has been shipped to the Danish Atomic Energy Commission by North American Aviation's Atomics International Division, which has also put into operation a small sodium reactor developed for AEC.

Danish reactor is a "solution" type, designed to operate at a power level of five watts. Denmark will use the device for research and training in reactor operation, technology and physics, radio chemistry, and production of radioisotopes.

Three other research reactors are being built for foreign installation, including one for the Japan Atomic Energy Research Institute near Tokyo, one for University of Frankfurt and another for West Berlin, Germany.

The civilian power reactor uses liquid sodium as a coolant, the same coolant which caused difficulties in the nuclear submarine Sea Wolf.

Atomics International will test the nuclear characteristics of the reactor and operation of the components. Though highly corrosive to piping which carries it, liquid sodium is still regarded as a useful coolant by some nuclear authorities. The North American reactor is one of several in an AEC civilian power program.

Britain Presents Iraq With Five Hunter Jets

Baghdad—Britain has presented Iraq, her Arab partner in the Baghdad Pact with five Hawker Hunter Mark VI swept-wing fighters. The fighters, requested by the Iraq government, are now based at the Royal Iraqi Air Force base at Habbaniya.

The British gift includes the supply of spares for three months, free delivery of the aircraft to Iraq, and a free servicing party to assist the Royal Iraqi Air Force in maintaining the aircraft.

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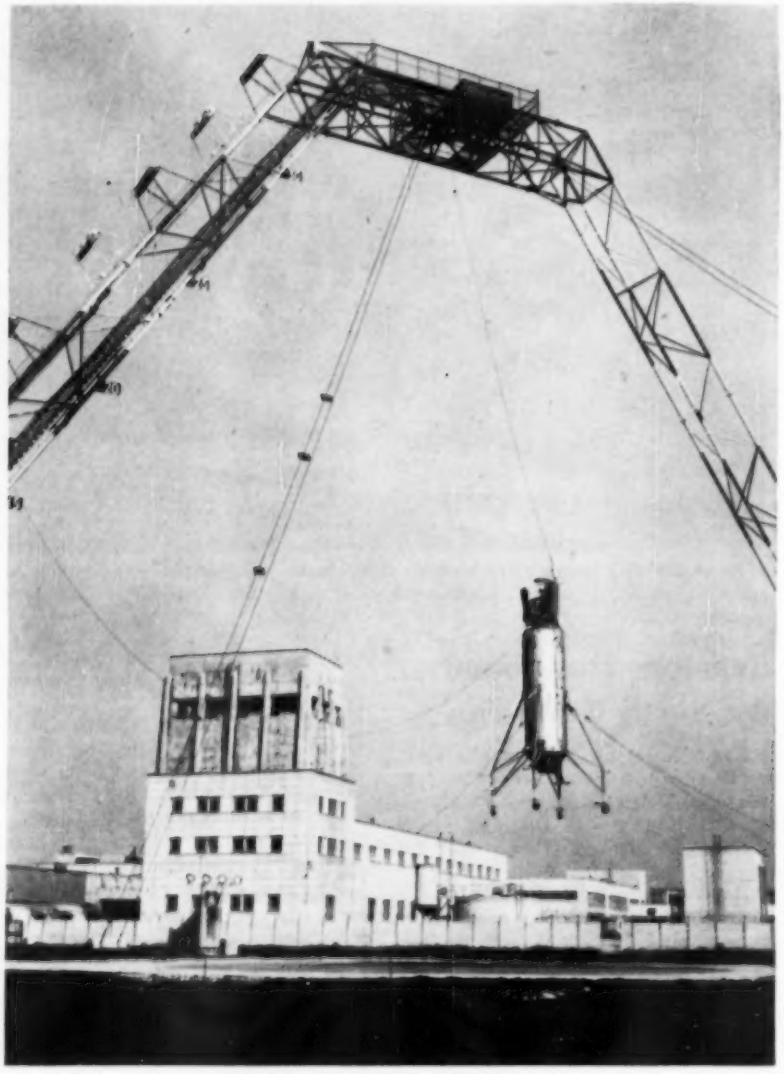


Atar P2 In Flight

Pilot takes Flying Atar P2 off ground under its own power. The Snecma craft soon will be flown away from its gantry and without ropes, which are used above only for safety. P2 eventually will be converted into coleopter, designated C-450. Tip-up seat for pilot has been installed; annular wing will be added.

Paris Show to Include F-104, KC-135 Flights

Paris—French officials expect the Lockheed F-104 Starfighter and Boeing's KC-135 aerial tanker version will be on flying display during the Paris Air Show May 24-June 2.

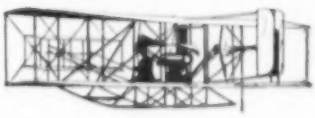
Twelve countries, in addition to the host nation, will participate, compared with nine in 1955 when the international air display was last held. Most major American airframe and engine builders will be among the 215 exhibitors.

Soviet participation has been requested, but so far the French have received no answer. The only Iron Curtain nations now scheduled to appear are Poland and Czechoslovakia. Both will exhibit tourist and agricultural aircraft.

A number of French prototypes, never before revealed to the public, will be on static display and some will take part in the flybys programmed for June 1-2.

These aircraft will include Sud Aviation's Trident II and Durandel interceptors; Nord's Gerfaut II; Dassault's Etendard IV and VI, tactical support fighters, and its Super-Mystere B2 production fighter, and Breguet's Alize anti-submarine turboprop aircraft and its lightweight attack fighter, the 1100.

Marconi's hand in World Aviation



Marconi's began research in air-to-ground radio in 1906. When World War 1 broke out their first airborne set was in production. Its range exceeded the range of the aircraft carrying it and the range of all subsequent Marconi air communication equipment has kept step with the increase in aircraft ranges. By 1920 Marconi's were engineering airport radio systems and incorporated direction finding in them in 1929. They demonstrated 'radar' principles in 1932. By 1938 they had combined auto pilots with ADF. The air defence of much of the free world today relies on Marconi radio and radar equipment. For civil aviation they are providing complete miniaturised airborne radio stations and radio navigational aids for many of the world's most advanced aircraft as well as engineering integrated radio communications, beacons, navigational aids and radar systems for some of the world's busiest airports. Marconi foresight and enterprise, backed by unsurpassed experience, is at the service of all who operate the aircraft and airfields of the present or plan the future.

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LG 15

Systems engineering–38th parallel style

Here's the challenge we received from the Korean Civil Assistance Command and the U. S. Army Signal Corps:

Build a telephone communications system to their specifications that will function over mountainous terrain. Cost to be within reasonable limits . . . upkeep minimum . . . equipments compatible with the experience and background of the population.

The answer is the system now being installed in South Korea.

Manually operated telephones, central offices and PBX switchboards, suited to a civilian population unfamiliar with dial methods.

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Turbomotor Describes Light Engine Bid

New York—First indication of how Curtiss-Wright Corp.'s Turbomotor Division will attack design of small gas turbines was a description of a 2,000 lb. turbojet for supersonic flight given by three Turbomotor engineers before a recent meeting of the Society of Automotive Engineers here.

Acquired over a year ago by C-W, the Princeton, N. J. division is described by Chief Engineer Norman C. Whitbeck to be interested in any turbojet or turboprop up to 7,500 lb. thrust or shp. respectively. The 2,000 lb. thrust turbojet discussed before the SAE is but one of a family of small engines which Turbomotor has considered. The actual designs which it will develop are aimed at particular armed services requirements.

Whitbeck explained that the 2,000 lb. thrust engine was not the J1A which has been mentioned in connection with Turbomotor. But he said that this engine was a representative approach.

Thinking behind the engine design was based on military need for a small powerplant for a Mach 2-3 vehicle which could be a drone, an aerodynamic missile or a man-carrying trainer. The Turbomotor engineers found that for Mach 2.5 performance they would be able to use a 1,700F turbine inlet temperature, a compression ratio of six and yet have only 170 lb. of engine.

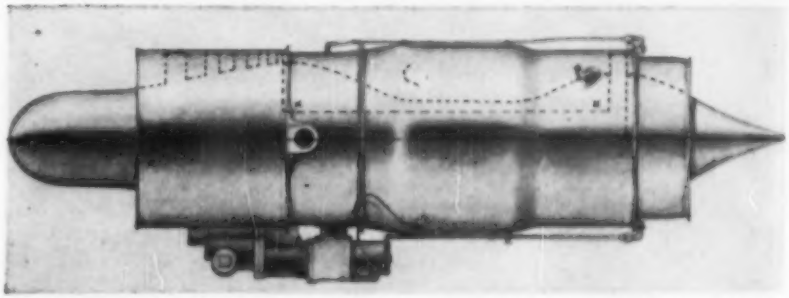
Afterburner Use

For missions in the 400-2,000 mi. range they would not recommend a straight turbojet. Afterburners would only prove useful for ranges of less than 400 mi. at speeds of Mach 3, but even in this case alternate increase of turbine inlet temperature to 1,960F with turbine cooling might prove more attractive.

The study accounted for effect of specific fuel consumption by including the fuel weight with the engine weight in the propulsion system analysis. According to the Turbomotor engineers, it would be possible to offset the higher fuel consumptions of smaller engines by the extra fuel capacity which lighter weight would permit. They reasoned that it would be possible to replace one large turbojet by the equivalent thrust divided between a number of small turbojets, plus necessary extra fuel, and gain in the exchange.

A contrary view was that of C. A. Grinyer, vice president of Orenda Engines Ltd., Toronto. By the time small engines are installed, he said, their higher frontal drag, higher cost per pound of thrust and greater control complication will more than offset benefits of "two-thirds" scaling. Thus on one side of the argument a large engine designer says that eight engines of 2,250 lb. thrust will not replace one 18,000 lb. thrust engine (Orenda's Iroquois), on the other side a small engine designer believes that his product will permit a smaller investment in engine-airframe (two-thirds for the Turbomotor example) to carry the same payload.

The debate on the threat of a multiplicity of small engines to usurp the domain of the large engine will go on for at least the next two generations of aircraft. Actually the British Short Bros. SC.1 which uses five 1,000- lb. thrust engines is one of the few prototypes in existence based upon the concept.



TURBOMOTOR sketch of proposed lightweight supersonic turbojet. Probable internal flow geometry has been added by Aviation Week. Obvious features are large hub compressor, simple monocoque shell, and mechanically driven fuel and oil pumping systems below compressor case. Since a turbine air impingement starter is shown, it is possible that the bullet nose is not used for an electric starting motor and is actually rotating with the compressor and cantilevered off a bearing in the mid-frame aft of the compressor.

Weight: 170 lb.

Most remarkable feature of the engine design which emerged from the Turbomotor study is its light weight. Turbomotor would have no difficulty in producing an 170 lb. engine with a thrust-to-weight ratio of 12:1, the study asserted. In the future, Turbomotor believes it could further pare the weight to achieve a ratio of 15:1.

Thrust-to-weight figures proposed by Turbomotor are considerably better than those predicted for 1965 by A. T. Gregory, Chief Engineer, Fairchild Engine Division, Deer Park, N. Y. The Turbomotor specific fuel consumption, "considerably below 1.0" appears more or less similar depending upon what Turbomotor means by "considerable."

Other features of the Turbomotor design:

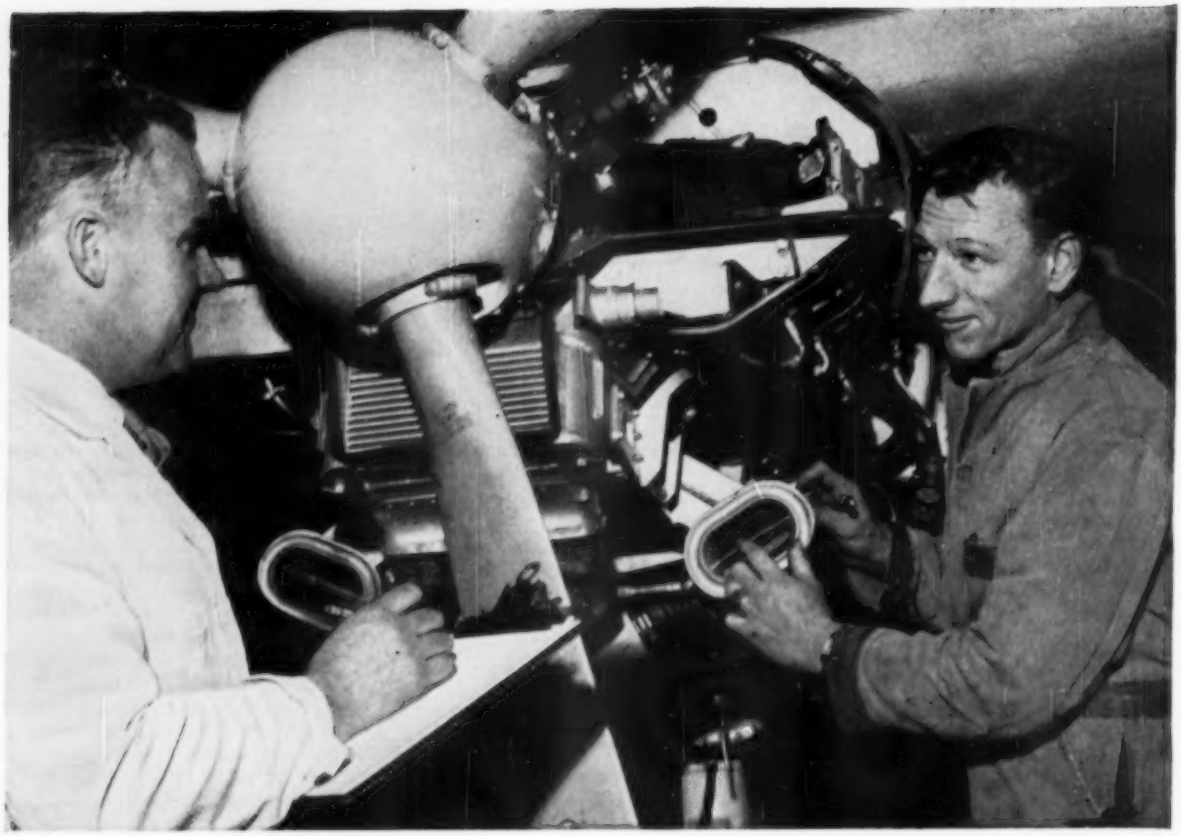
• **Bullet nose,** which may possibly be an extension of the main shaft. For small engines at or under 14-18 in. diameter, it is possible to move the forward bearings back behind the compressor, Whitbeck said. It depends on whether the gyroscopic loads under the aircraft's accelerations, which can be as high as 15 G for drones and missiles, will cause the first compressor stages to rub against the compressor casing.

• **Short, lightweight compressor.** Since most of the compression will come from the aircraft's multiple shock inlet only five compression stages are needed. As the fat bullet nose indicates, the compressor blades will be relatively short. Turbomotor mitigates the adverse Reynolds number effect in small compressors by using short, wide compressor blading rather than the long narrow blades popular in larger engines as the GE J79 to keep engine diameter down. The compressor follows the current trend of employing transonic blading in the first stages.

• **Mid-frame and engine** envelope shell are mostly of simple sheet metal design. Engine disassembly for maintenance would be performed by breaking the engine case at one of the vertical flanges and pulling the rotating members out rather than removing half a split case to uncover the rotating members as is the practice on larger engines. Turbomotor said that the shell would be a straightforward sheet steel structure with only a normal spacing of stiffening frames. As mentioned previously it is likely that the mid-frame may contain the forward bearing supports.

• **Combustor** of "conservative" dimensions. Though it would take up most of the volume, the combustor is not expected to add a proportionate amount of weight. The fact that the gas residence or dwell time in the combustor cannot be scaled down to suit small turbines is an aggravating limitation in the design of compact miniature turbines.

• **Turbine** is one uncooled stage. Because the compressor is short and the



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turbine has to withstand high temperatures, both will weigh about the same. The weight saved in these members and their connecting shaft will be the greatest contribution to the engine's overall light weight. In this connection it could be argued, since the airframe's inlet contributes significantly to the engine's performance, its weight ought also to be included before this supersonic engine can be compared in weight to a subsonic engine.

• **Nozzle**, which is said to be of the isentropic external plug type. This has the advantage of being short and light. For Mach 2.5 flight, a converging-diverging nozzle would be needed.

• **Fuel pump** and control and oil system are mechanically driven from the engine shaft and are located at the mid-frame under the engine. Oil feed and return and fuel delivery lines are led from this point.

Pneumatic Starts

A small turbine impingement nozzle is added for pneumatic starts.

The pneumatic energy could be supplied either from external compressors on the ground or from charged bottles in the air.

Because the airflow to produce 7,500 hp. in a turboprop is only 75% that needed to produce the same figure in jet thrust with present engine temperatures, it can be seen that Turbomotor's largest turboprops will be smaller than their largest turbojets.

This is in line with the general industry tendency to hold the size of turboprops with heavy complicated reduction gearing below that of less complex turbojets.

The division will have access to foreign engine developments which result from engineering assistance and licensing agreements which the parent company has with Armstrong Siddeley, and Bristol Aero Engines Ltd. in England, and Daimler-Benz, Germany.

Test Stage Is Near For Fairey Rotodyne

London—Fairey Aviation Co.'s 40-seat Rotodyne helicopter is due to start ground trials and flight testing in the next few weeks.

Dr. G. S. Hislop, chief helicopter designer at Fairey, commenting on the noise problem, said: "We think the results we have achieved are as fruitful as anything done anywhere in the world." The company is trying to reduce the noise of the helicopter's takeoff to "an acceptable level for city center operations."

The Rotodyne has been designed to British European Airways specifications. It will carry 40-48 passengers or 10,000 lb. of freight.

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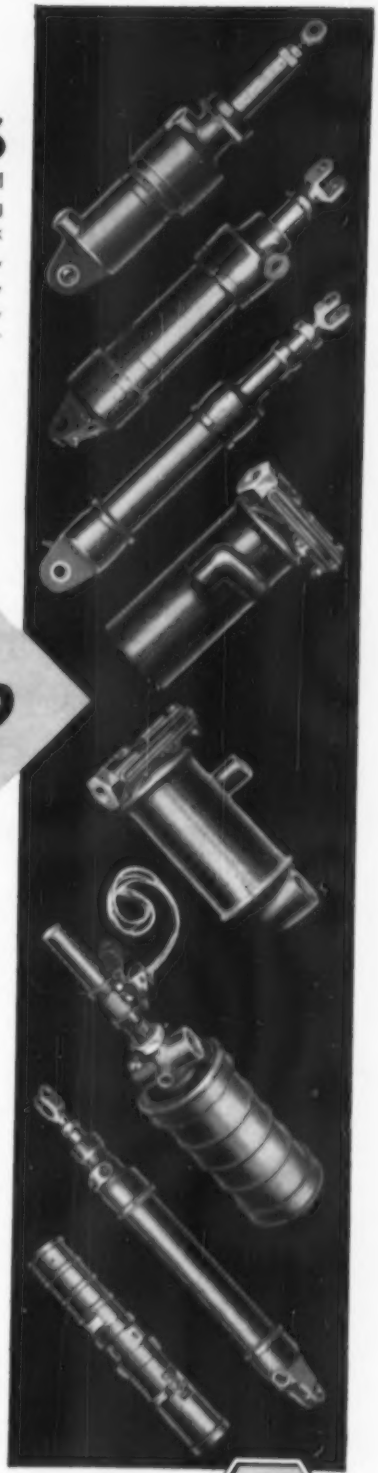

Shown here are major types of hydraulic cylinders, precision-fabricated by Weatherhead to strict specifications for leading manufacturers of military, commercial and civilian aircraft. No matter how "out-of-the-ordinary" your cylinder requirements may seem, look to Weatherhead . . .

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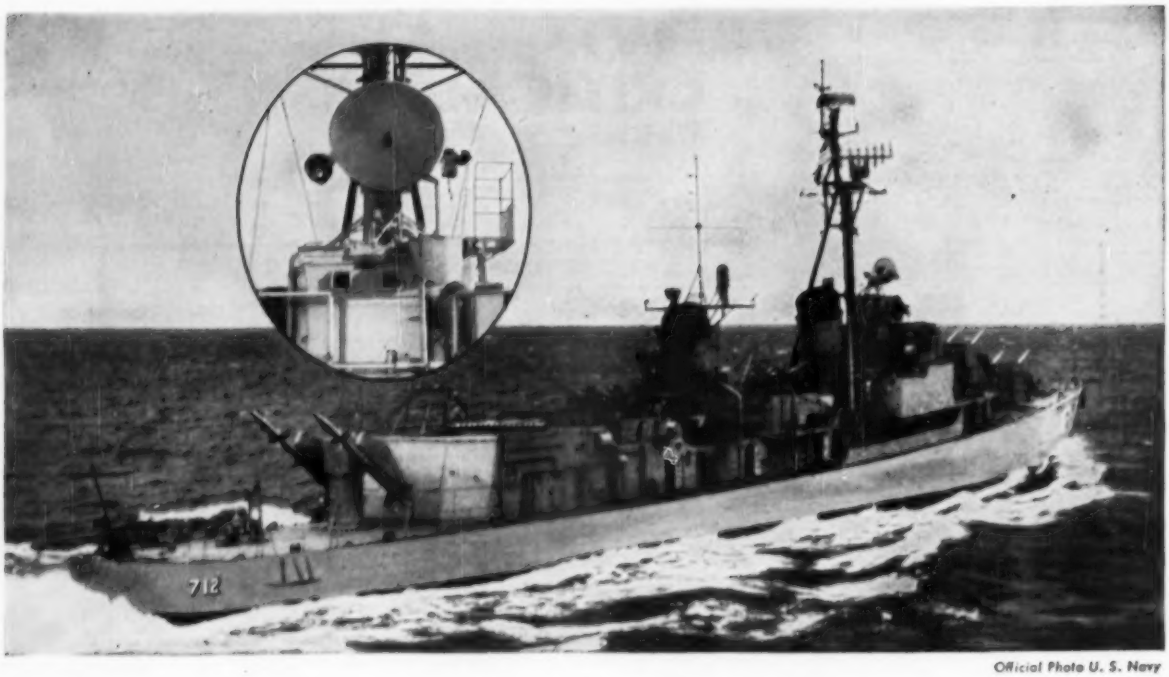

Official Photo U. S. Navy

unique dual-role radar guidance system by Reeves INSTRUMENT CORPORATION

Developed for U. S. Navy Bureau of Ordnance

Twin Terrier Missile Launchers, shown in this official Navy photo on the after-deck of the USS Gyatt, give the world's first guided missile destroyer an atomic-age weapons system equal in range, accuracy and striking power to that usually associated with a 45,000-ton ship.

Key to this successful installation of the supersonic Terrier system in the close quarters of a destroyer is the unique new Reeves **combined** automatic missile radar guidance and fire control system, developed out of Reeves' experience with previous successful Terrier installation "firsts" in the cruiser USS Boston and in the battleship USS Mississippi.

While serving the dual role of automatic radar tracking and guidance for the Terriers, as well as fire control for the destroyer's 3" and 5" guns, this new Reeves system is compact (as shown by inset photo above), has great range and precision, and is capable of self-monitoring. It requires few operating personnel.

Here is yet another example of Reeves' close and highly successful association with the U.S. Navy and other branches of the Armed Forces in many of the military electronics projects that have been or will be recorded as dramatic "firsts" in their fields. Reeves research, engineering and unique precision manufacturing facilities are specifically geared to this pioneering tempo.

helps Navy's first guided missile destroyer pack a battleship's wallop

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3RV57A

Jet Engine Fuel Control Test Is Discussed at Symposium

By Robert Cushman

Detroit, Mich.—How realistically engine fuel control systems must be tested before shipment was argued at a turbojet Engine Symposium here sponsored by Vickers, Inc.

Essentially the controversy boiled down to whether it is necessary to incorporate complete closed-loop engine simulation, as in the new $100,000 Vickers test stand, or whether more straightforward open-loop $50,000-100,000 test stands are still adequate for production testing.

What Vickers has proposed for future engine fuel control system production check-out stands is a production test unit nearly as elaborate as the development type rigs now used by firms as Bendix Products and General Electric Co. in developing new jet engine fuel control systems.

Controller Drive

The Vickers fuel control test stand simulates the fuel controller operation on an engine by driving the controller with a variable speed hydraulic transmission just as it would be driven off the engine's accessory pad.

The hydraulic transmission's speed is controlled as a function of the effect that the controller's fuel output would have upon the engine concerned. The Vickers stand does this by measuring the controller's fuel flow output and using this to control the output of the hydraulic transmission pump.

Between the fuel flow signal and the transmission pump, Vickers modifies the signal to represent the typical response lags of the jet engine. The function generators and analog computers which are the heart of the simulator can be varied to correspond to the behavior of the particular engine for which the controller is slated. In the case of the present Navy Bureau of Aeronautics sponsored Vickers test stand, the function generators represent the Westinghouse J34 turbojet.

Dynamic Test

Two modes of testing are possible with the Vickers stand, transient and steady-state. In dynamic or transient testing, the main variable in the controller-plus-stand control loop is the engine throttle on the controller. For more conventional steady-state testing it is possible to set a particular rpm. on the test stand.

On a typical dynamic test, the operator would throttle burst the controller from idle to military rpm., then note on the x-y plotter whether the controller-simulated rpm. was held within specification limits. This test would indicate whether the controller, when it was installed on an engine, would schedule in enough fuel to accelerate the engine as fast as possible without bringing the engine's compressor too close to its surge margin.

This much can be done by many conventional open-loop test stands, as those made by Consolidated Diesel, Stamford, Conn., and Greer Hydraulics, Inc., Jamaica, N. Y.

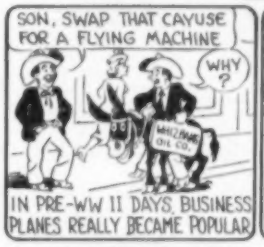
What the Vickers closed-loop design adds to the controller check-out is recording to what degree and for how long the controller will interact with the engine once it has leveled off at the desired new speed. By plotting the fuel-flow and rpm. oscillations as they settle out, the Vickers stand depicts the controller's response and stability characteristics.

Symposium reaction to concept of dynamic engine simulation on a production fuel controller test stand was varied. Some thought it more a de-

SAC Silver Jubilee Newsreel

by JACK PATTON

OK, MEN... LET'S GET THOSE SIGNALS STRAIGHT!
SMU
1940: EX-GRIDDER HARLAN RAY JOINED GEO. W. JALONICK III AND WINSTON CASTLEBERRY TO BUY CONTROL.



Good ideas long have characterized Southwest Airmotive and those with whom it deals. Guiberson Corp.'s radial Diesel engine powered this Gull Wing Stinson in pre-WW II experimental flights throughout the Western Hemisphere.

Winston Castleberry's first loyalties are for customers and for the craftsmen who, since the '30's, have worked so closely with him in his role as a SAC owner and service boss. Here, he presents an anniversary gift to Hunter Louis Beimer, Engine Division chief.

1932 A QUARTER CENTURY OF LEADERSHIP 1957

Southwest Airmotive Co.

LOVE FIELD DALLAS

DIVISIONS: KANSAS CITY, KANSAS / DENVER, COLORADO

Look to the Sky

Military, commercial and private aircraft show the shape of progress of a flying America. How many of these planes can you identify from this partial listing of Camloc users? Clue: They all have one thing in common... Camloc fastening devices.

1. _____

2. _____

3. _____

(RESTRICTED)

4. _____

5. _____

6. _____

7. _____

8. _____

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30. _____

To know your country's aircraft best, fly them! America's air arm needs more young men as pilots and technicians to keep our first line of defense ever strong, ever alert.

CAMLOC®

FASTENER CORPORATION

velopment type tool and too elaborate for an automatically scheduled and recorded go-no-go test device. Others felt that the greater fuel controller complexity and higher rates of response demanded of future gas turbines will require this fundamentally more direct method of testing.

Dr. Gerhard Reethof, chief of research at Vickers, said that future control actuators which have to operate in over 700F degree environments may either be hot gas pneumatic systems, or liquid metal hydraulic systems.

• **Hot gasses,** generated by solid or liquid propellants and operating for 1-2 minute flight durations can produce response rates comparable to present hydraulic systems if they work at suitably high pressures, Reethof said.

• **Heavy metals,** as mercury, appear attractive for hydrokinetic devices such as impulse turbines, pitot turbines and ram type motors. These hydrokinetic devices will use the momentum of the fluid rather than the high pressures with low velocities characteristic of present hydraulic positive displacement units. Unfortunately, mercury is even more toxic than the present high temperature hydraulic fluids which are expected to go to 550F.

Sodium-potassium eutectics are examples of other metals with low enough melting points to be attractive for high temperature actuators.

This was the second year for the Vickers sponsored symposium. Although company products are included in the agenda, Vickers tries to make the two-day schedule more of a general engineering discussion between U. S. and foreign representatives interested in gas turbine engine control than is customary with privately sponsored symposiums.

America's aircraft manufacturers are doing much to preserve this country's freedom and further its progress with rapid and constant aeronautical achievements. Camloc is proud to be a supplier to this pace-setting industry... proud that its fastening devices are on the planes that America flies.

ANSWERS

1. A3D	Douglas	16. F-102A	(convair
2. A4D	Douglas	17. F-104A	Lockheed
3. F-4D	Douglas	18. F-105	Republic
4. F-5D	Douglas	19. F-106	(convair
5. DC-6B	Douglas	20. C-123	Fairchild
6. DC-7C	Douglas	21. C-130	Lockheed
7. DC-8	Douglas	22. C-133	Douglas
8. F-8U	(Vance Vought	23. KC-135	Boeing
9. M-21	Veriol	24. 188	Lockheed
10. PA-23	Piper	25. 310	(cessna
11. B-52	Boeing	26. 440	(convair
12. B-58	(convair	27. 680	Aero (commander
13. S-58	Sikorsky	28. 707	Boeing
14. B-66	Douglas	29. 880	(convair
15. F-100F	North American	30. 1649A	Lockheed

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FJ-4Bs Delivered for Test

First two FJ-4Bs, which are equipped with new type speed brakes (below), were delivered to Naval Air Test Center, Patuxent River, Md. for test. New Fury carries auxiliary stores, bombs, has stability improvements for low altitude use.

Charts Offer "First Pass" Design Check

Used as an aid in the preliminary design of aircraft at Convair (Ft. Worth) Division of General Dynamics Corp, this manual provides a short-cut method. It reduces the time and effort required to analyze large numbers of new designs before detailed comparisons are made of the more promising configurations.

Sherman V. Brunk, author of this manual, has over 17 years experience as an aeronautical engineer, the last five years in preliminary design. Mr. Brunk prepared this handbook in the course of his normal work.

Publication of this manual by AVIATION WEEK has a double purpose: to allow engineers engaged in similar work to compare their methods with those used elsewhere and to provide basic information for the further education of those in the aircraft industry who are unfamiliar with this particular design phase.

This information concerning aircraft will be followed shortly by an article on missile design by Prof. K. D. Wood of the University of Colorado. This article is the latest of Prof. Wood's extensive aeronautical writings. It will present the data necessary for predicting the performance of a winged missile.

By Sherman V. Brunk

Many engineers, for their own use, have in the past made graphs which are similar, in part or whole, to those contained in this handbook. The graphs with all the variables concerned for a "first and second pass" evaluation of a design are put together for the handy use of the engineer.

This handbook is not intended to replace the classical tools of the aerodynamicist; however, it is intended to give the preliminary design engineer a pictorial view of the trades and advantages to be obtained by variations of the factors involved.

For evaluation of an airplane, a working knowledge of the aerodynamic formulas are essential. Following is a list of the formulas used in the graphs and others that must be used.

(1) $q = \frac{1}{2}\rho V^2 = .7M^2P$

(2) $C_L = \frac{W}{qS_w}$

(3) $C_{Dmin(subsonic)} = \frac{Aw}{S_w} \times C_{D_f}$

(4) $C_{Dtotal} = C_{Dmin} + \frac{C_L^2}{\pi AR^e}$

(a) $C_{Dtotal} = 2C_{Dmin}$ (at L/D Max)

(5) $T = D = (C_{Dtotal})(q)(Sw) = \frac{W}{L/D}$

(6) $L/D_{(subsonic)} = \frac{C_L \text{ (for } L/D \text{ max)}}{C_{Dtotal}} \frac{1}{2} \sqrt{\frac{1}{C_{Dmin} \frac{1}{\pi AR^e}}}$

$L/D_{(actual)} = \frac{C_{L(actual)}}{C_{Dtotal}}$

$(L/D)_{max(supersonic)} = \frac{1}{2} \sqrt{\frac{1}{(K)C_{Dmin(supersonic)}}}$

(8) $K = \frac{C_{D_L}}{C_L^2}$

(9) $C_{Dmin(supersonic)} = C_{Dmin(subsonic)} + C_{D(wave)}$

(10) Range $= \left(\frac{V}{SFC}\right)(L/D) \ln \frac{Wo}{We}$

Terms:

Aw = Total airplane wetted area in ft.²
C_D = Coefficient of drag
C_L = Coefficient of lift
C_{D_f} = Coefficient of friction
D = Drag in pounds
e = Span efficiency
q = Dynamic pressure in lbs. per ft.²
M = Mach No. = velocity divided by speed of sound
V = Velocity in knots
Sw = Wing area square feet
T = Thrust in pounds
P = Pressure in lb./ft.²
ρ = Density in slugs/ft.³
Wo = Gross wt. full up
We = Gross wt. minus fuel
SFC = Specific fuel consumption (lb. fuel/lb. thrust/hr.)
AR = Aspect ratio

This handbook consists of six charts, which were developed over a period of several years as a means of obtaining quick evaluation of an existing design, or for better "first pass" original designs.

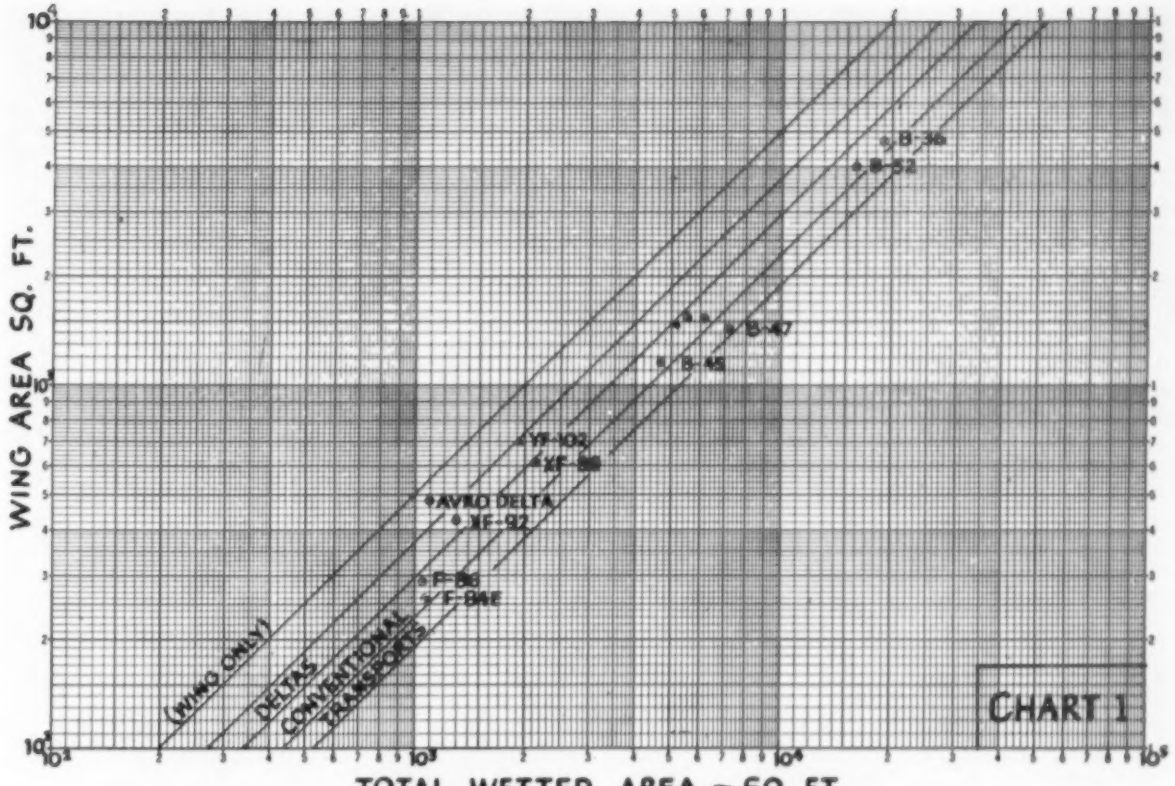
Chart Explanation

Chart I shows the general relationship of total airplane wetted areas to the wing area. It is most useful at the preliminary stage of an airplane conception. One should exercise care to be conservative because the airplane in particular can be either to the right or left of the section denoted as to type, depending upon its own characteristics. As an example the Comet airliner could be expected to fall well within the conventional bracket, whereas the B-47 will fall farther to the right of the guide lines because of the externally mounted engines even though it does not have a large transport-type fuselage.

Chart II shows variables and is useful in selecting the aspect ratio desired for a particular design function. This chart is useful both for subsonic and supersonic calculations. When using this chart for supersonic calculations enter at the proper "K" factor and proceed across the sheet as shown in the example. The (C_{Dmin}) is figured from Chart I using (Aw and (Sw.) The (C_{Df}) used will vary with type of airplane, finish, etc., but will usually fall between 0.0040 or 0.0027. Most high speed aircraft nowadays will be around 0.0033 or 0.0034. The common span efficiency used today and readily attainable is 0.80. From this information the horizontal projection of "K" factor, or aspect ratio, and span efficiency to the vertical intersection of ($C_{Dmin.}$) gives (L/D max.) and $C_{L\ (L/D\ max.)}$ This will give the airplane capabilities, for the variables selected, provided the power is available. Another way of looking at it would be to say, that since the airplane will probably be operating at something less than maximum, this procedure gives a measure of growth potential.

Chart III actually consists of two formulas superimposed upon the same base line. The first ($M = \frac{1}{2}\rho V^2$) has been set up to give altitude, Mach number and dynamic pressure. The second $\left(\frac{W}{S_W} = C_L q\right)$ will give dynamic pressure, wing loading, and coefficient of lift. This chart is especially useful for a number of reasons: it will give altitude capabilities, wing loading capabilities, the actual C_L at given conditions, and the dynamic pressure at which the airplane is operating. Perhaps the greatest use is the pictorial value of the trades which can be seen and evaluated on the spot.

To use the chart enter on the left at Mach number selected and proceed to the right across the chart until you intersect the desired altitude. Thence, proceed downward along a constant dynamic pressure until intersecting the horizontal line representing the desired wing loading. At



this intersection then read the actual operating C_L of the aircraft for steady state flight.

Wing Loading

As an example, suppose we have an airplane capable of Mach 2 flight with a (C_L for L/D max.) = 0.20 and we are to fly at 60,000, 70,000, and 80,000 ft. It is then desired to know what wing loading the airplane could carry under these conditions. From the chart we find that the wing loading capabilities are 80, 52, and 33.5 lb. sq. ft. respectively.

When a split mission airplane is to be designed, this chart is very useful in matching the airplane capabilities (i.e., subsonic to supersonic load carrying capabilities). When the engine selection is to be made, the thrust requirements can be found by using [$T = D = C_{Dtotal}$ (q) (Sw)]. This would result in a matched airplane.

These charts are by no means a panacea. However, they will enable the designer to come much closer on the first try to the airplane design desired, thereby reducing the work in the preliminary design and performance groups.

Summation

Chart IV is to give a pictorial summation to the designer of the effects of dynamic pressure, lift/drag, total airplane wetted area, and the coefficient of friction on the load carrying capabilities of the airplane. This chart can be used to give indications of the size aircraft required to give the desired characteristics. For example assume (q) = 240), and a weight of 250,000 lb. at an (L/D) maximum of 8.6. From the chart we would get a reading of 120 = ($2AwC_{Df}$). If we assume 0.0034 for the (C_{Df}) and solve for (A_w), we will find that (A_w) = 17,680 sq. ft. If this were to be a conventional type plane, from Chart I, we obtain a wing area of approximately 4,200 ft.^{2} Calculate (C_{Dmin}) by using the above information which will give (C_{Dmin}) = 0.0143. From Chart II we find (C_L) for (L/D max = 0.245) and an aspect ratio of 1.57 by assuming a span efficiency of 0.80. Of course this would be a very poor design but is used here for illustration purposes. Change the above conditions to read (L/D max = 15), holding the rest constant and you will get the following:

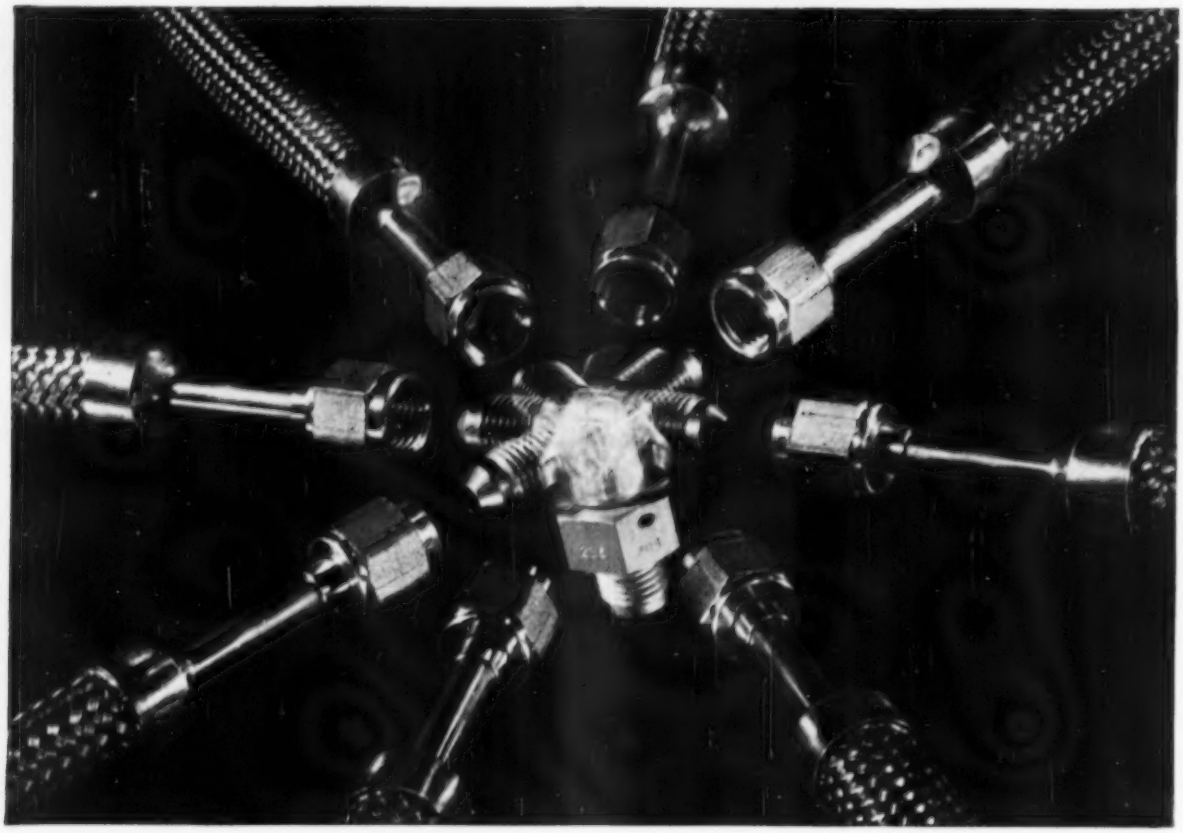
(1) S_w = 2500 ft.^{2} A_w = 10,300
(2) C_{Dmin} = .0140
(3) C_L for L/D_{max} = approximately 0.42
(4) Aspect Ratio = approximately 5.0

All this would correspond with an altitude of approximately 33,000 ft. with speed of Mach 0.80. From Chart III it can be seen that for a speed of Mach 0.80, if a higher altitude is desired, a lower (q) must be utilized with a slightly higher (C_L), and a consequent increase in (L/D) and aspect ratio.

Chart V provides quick access to the log ratio of the weight full-up to the weight minus fuel.

Chart VI is the classic range formula, $\left(\text{Range} = \frac{V}{SFC}\,(LaD)\ln\frac{Wo}{We}\right)$ and is especially useful for showing the trades in (L/D) and $\left(\ln\frac{Wo}{We}\right)$ ratios for a constant range.

To use the range charts, enter the top chart at the velocity and come across until intersecting the SFC line corresponding to the conditions selected. Proceed down the (V/SFC) line into the middle chart to the [L/D (actual)] intersection. This gives a range constant on a diagonal line. Enter lower chart on the same range constant until intersection of the horizontal projection of the $\left(\text{Ln}\frac{W_o}{W_e}\right)$ ratio, then read the range at the base.



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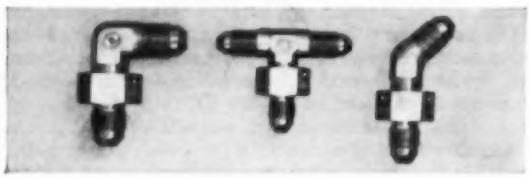

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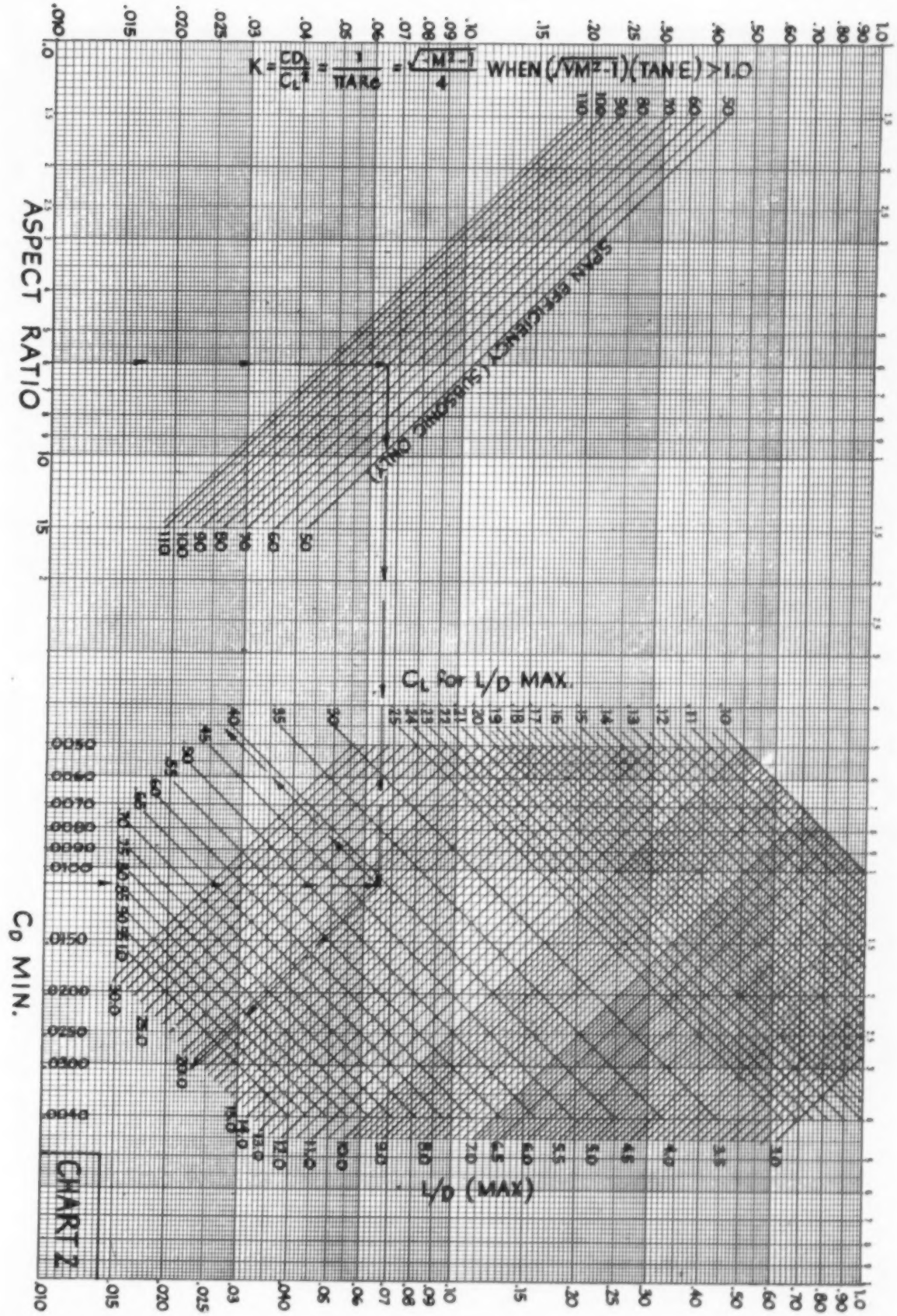
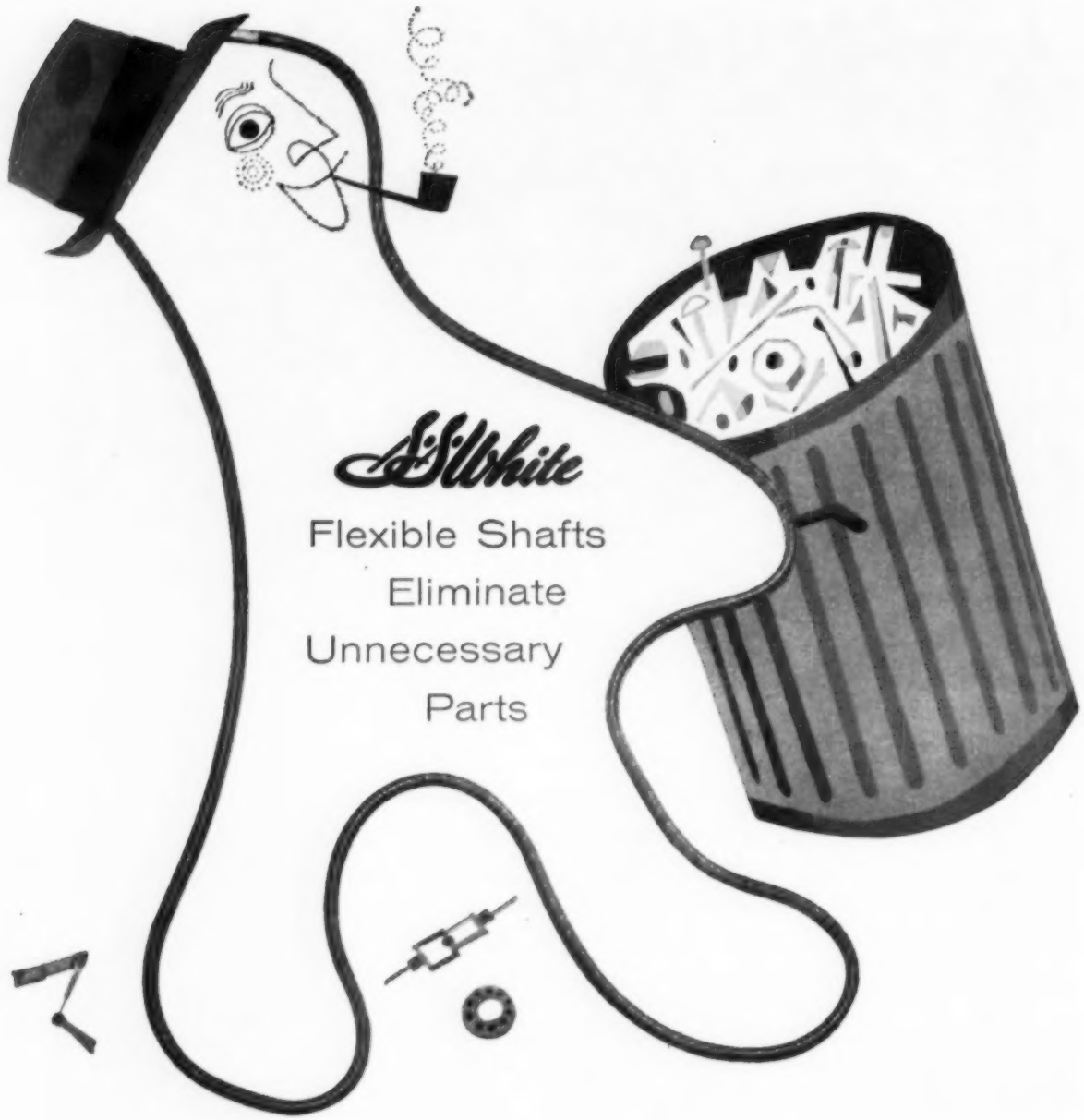

$K = \frac{CD}{C_L^2} = \frac{1}{\pi AR e} = \frac{\sqrt{M^2-1}}{4}$ WHEN $(\sqrt{VM^2-1})(\tan E) > 1.0$
SPAN EFFICIENCY (SUBSONIC ONLY)
ASPECT RATIO
C_L For L/D MAX.
C_D MIN.
L/D (MAX)
CHART Z



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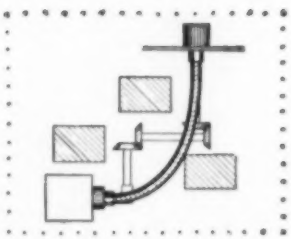

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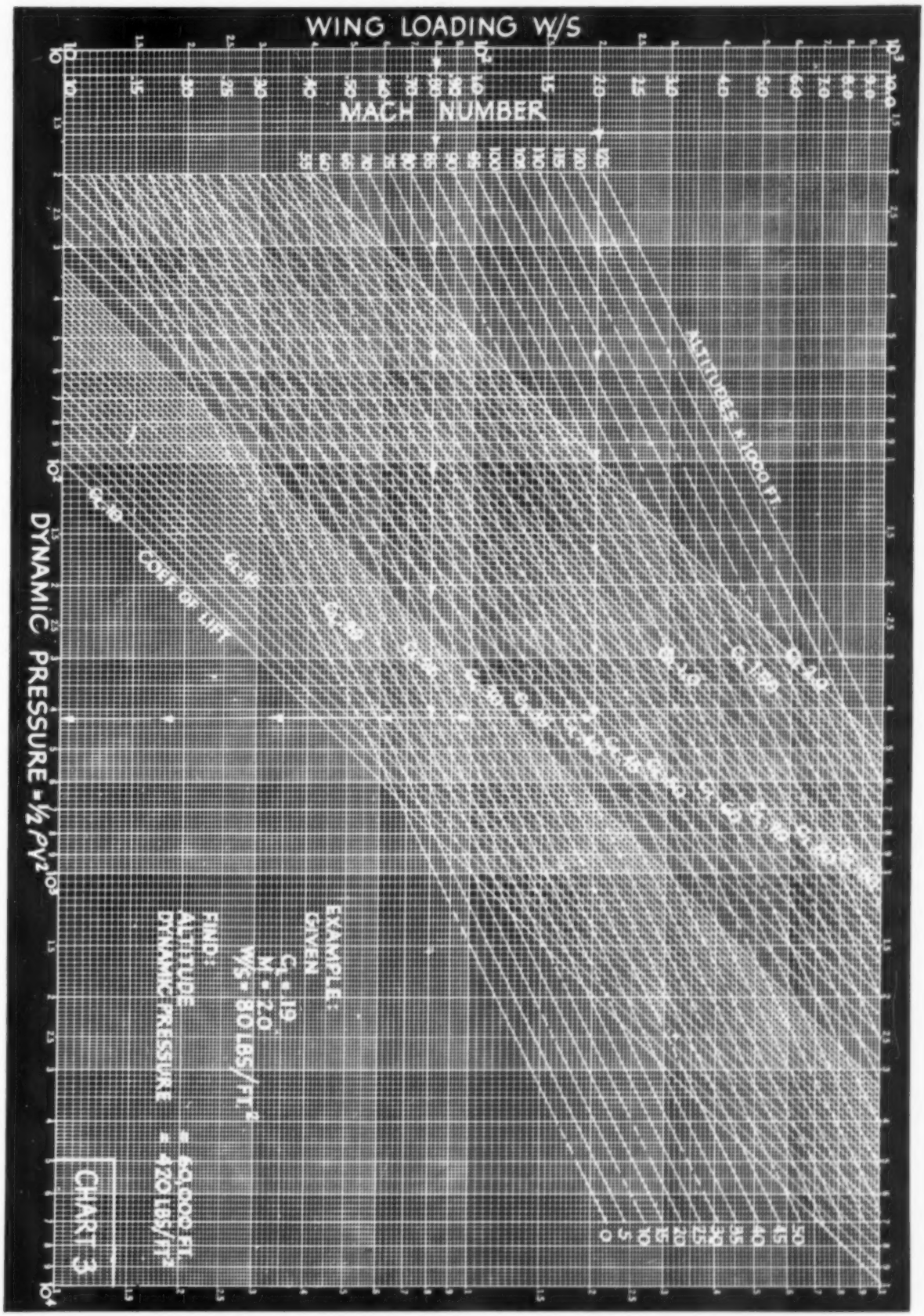
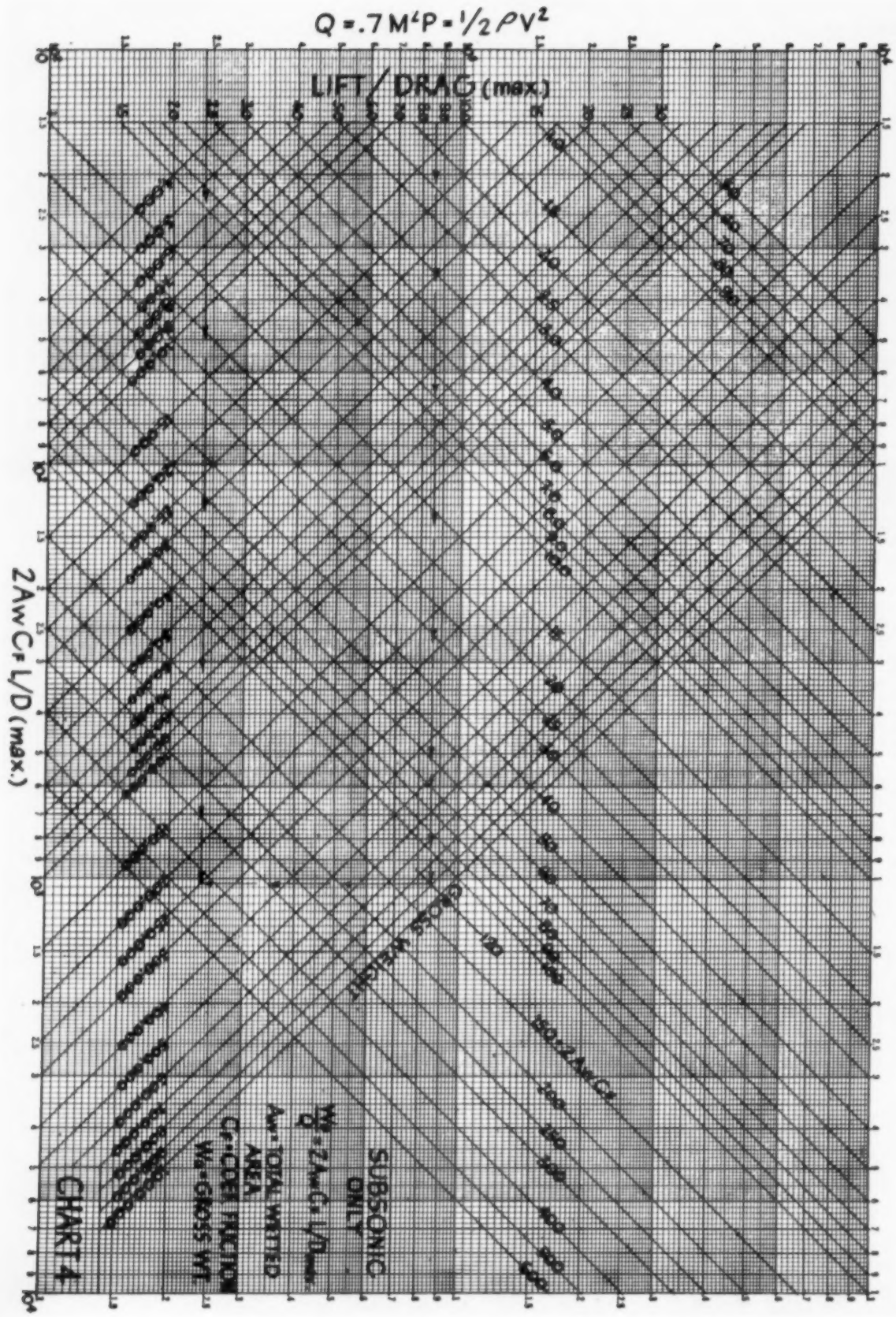

WING LOADING W/S
MACH NUMBER
DYNAMIC PRESSURE = ½ ρV²
ALTITUDE = 10000 FT
EXAMPLE GIVEN
CL = .19
M = .70
W/S = 80 LBS/FT²
FIND
ALTITUDE
DYNAMIC PRESSURE = 700 LBS/FT²
CHART 3


Q = .7 M² P = ½ ρ V²
LIFT / DRAG (max)
2 Aw Cf L/D (max.)
CHART 4
SUBSONIC ONLY
Aw = TOTAL WETTED AREA
Cf = COEF. FRICTION
Wg = GROSS WT.
GROSS WEIGHT

Each pound of reduced weight is worth something to you. The new Bendix Pygmies reduce connector weight drastically. These miniature aluminum connectors are for compact electronic equipment and aircraft use. Contacts are size 20 heavily gold-plated, featuring machined closed entry sockets. Choice of quick disconnect coupling between a modified double stub thread or 3 point bayonet lock. Provisions for grommet sealing, potting, cable sealing, conduit applications.

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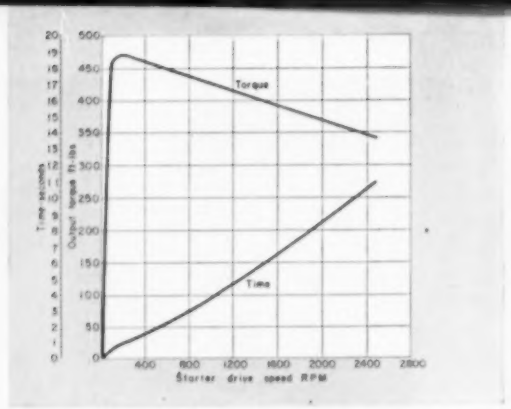
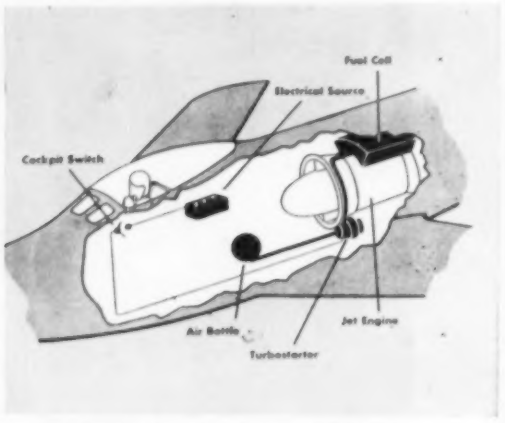
Production model of the General Electric fuel-air turbostarter for a current high thrust engine weighs only 46 pounds, has a $8\frac{3}{4}$ inch diameter and $12\frac{3}{8}$ inch length. Rated torque is 485 foot-pounds and a cut-out speed of 2500 rpm is reached in 10.8 seconds.



Fast starting capability of a turbostarter for a 525 lb-ft^2 moment of inertia jet engine is shown by this performance curve.



No ground assist is needed because the G-E turbostarter operates on the aircraft's self-contained air and fuel supply.

46 Pound Turbostarter Gives High Thrust Engines 25 Second, Push Button Starts

Integrated into turbojet or turboshaft propulsion systems, the General Electric fuel-air turbostarter gives aircraft unmatched take-off readiness. A single switch activates the starter. Fuel and air is combined and ignited. The resulting combustion gases are harnessed by a small turbine which is splined to the jet engine shaft through an overrunning clutch. Within 10 to 12 seconds the average engine is self-sustaining and the starter disengaged. Within an additional 13 to 15 seconds the engine will have reached idle speed.

Small, light, yet powerful

Small size and a high power-to-weight ratio makes the General Electric fuel-air starter ideal for both military and commercial aircraft. A current production model for an engine in the over 10,000 pound thrust class, weighs only 46 pounds, measures $8\frac{3}{4}$ x $12\frac{3}{8}$ inches; yet delivers 165 horsepower and a rated torque of 485 foot-pounds.

Logistical support simplified

The turbostarter operates on standard JP-4 fuel from the aircraft's tanks and pressurized air. Addition of a small compressor to the system to refill the aircraft's air bottle in flight eliminates recharging on the ground. The basic design advantage of few moving parts, combined with precision manufacture helps reduce wear, thereby minimizing maintenance and increasing starter life.

For more information on how this advanced turbostarter design can be applied to your particular requirements, contact your General Electric Aviation and Defense Industries Sales representative, or mail coupon below. Aircraft Accessory Turbine Dept., General Electric Company, Lynn, Mass.

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☐ immediate project ☐ reference only

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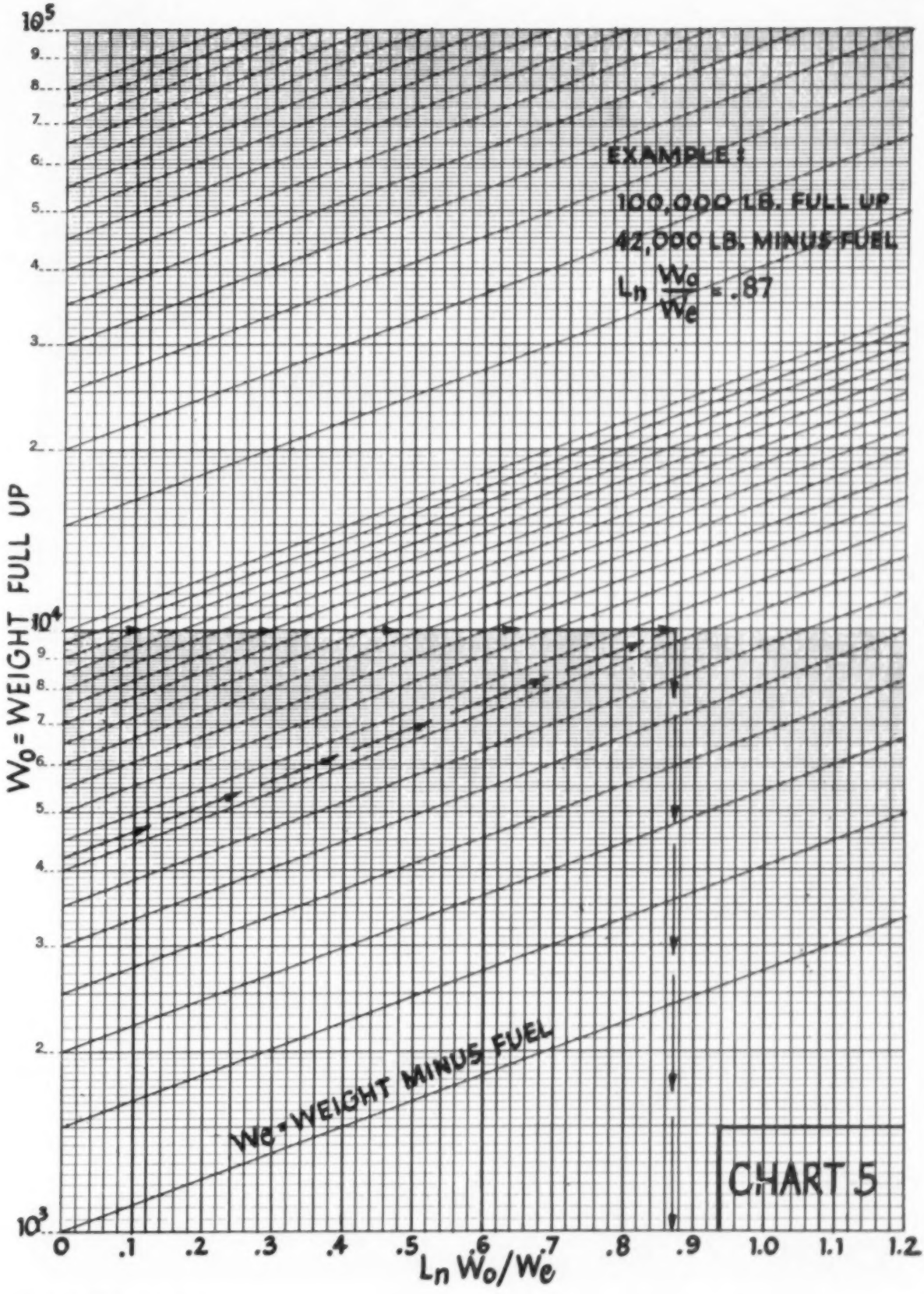
Position .....

Company .....

City ..... **Zone** ..... **State** .....


EXAMPLE:
100,000 LB. FULL UP
42,000 LB. MINUS FUEL
Ln Wo/We = .87
Wo = WEIGHT FULL UP
We = WEIGHT MINUS FUEL
Ln Wo/We
CHART 5

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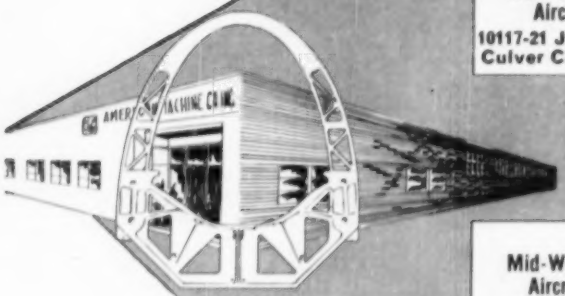

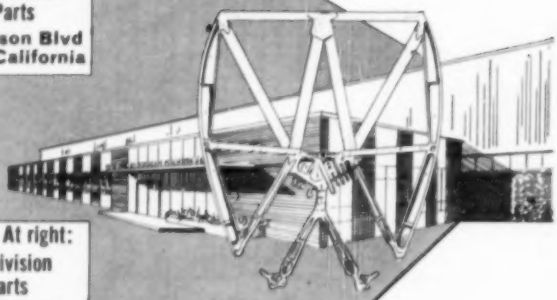

At right:
Mid-West Division
Aircraft Parts
1450 E. 19th Street
Indianapolis, Indiana

Illustrated above are typical structural machined aircraft parts and assemblies currently being manufactured in the two divisions. The aircraft divisions operate under Air Force approved Quality Control systems. Each division possesses the most up-to-date equipment for its specialty including many pieces of equipment designed around a particular part.....

Convair B-58

Boeing B-52

H&B

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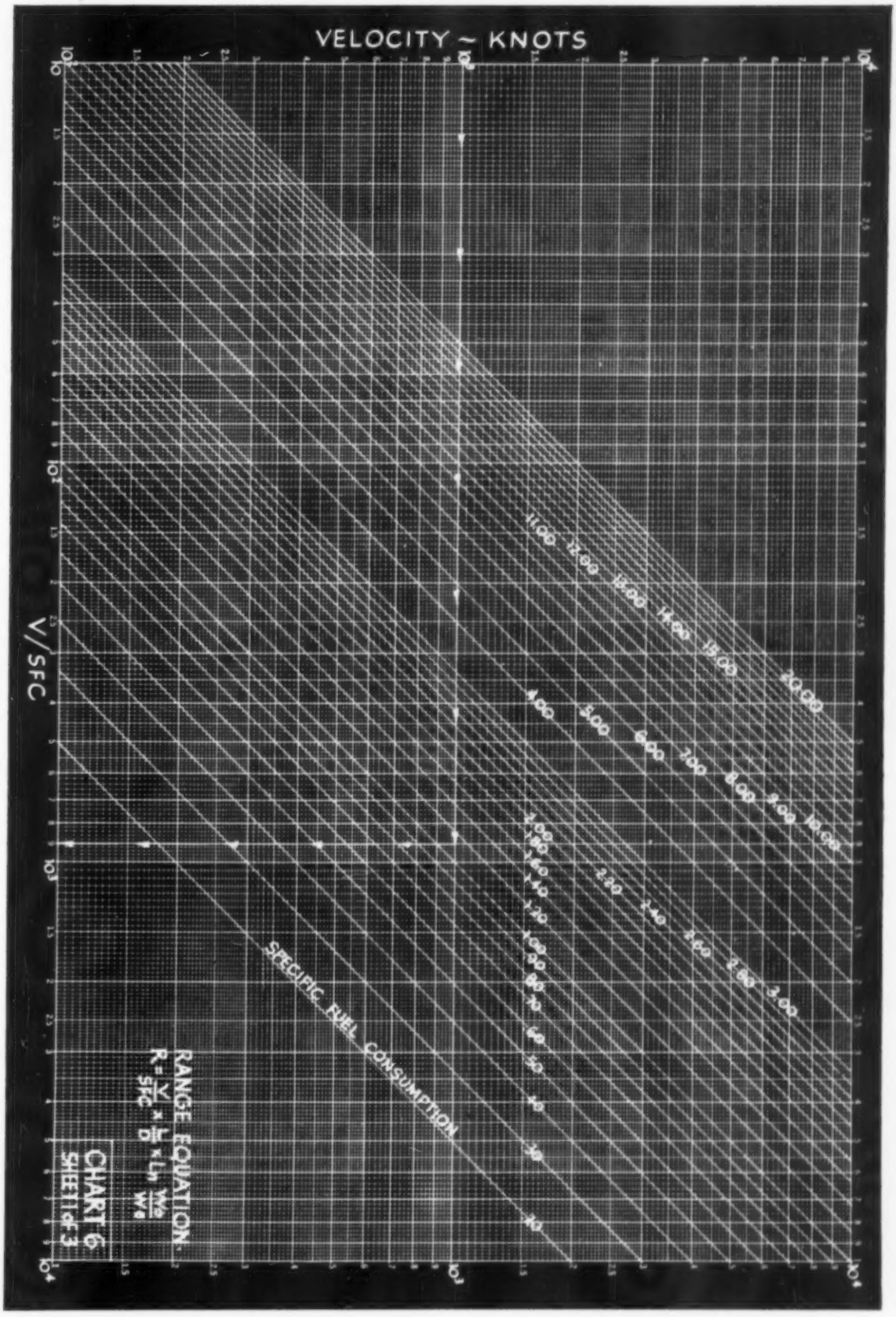
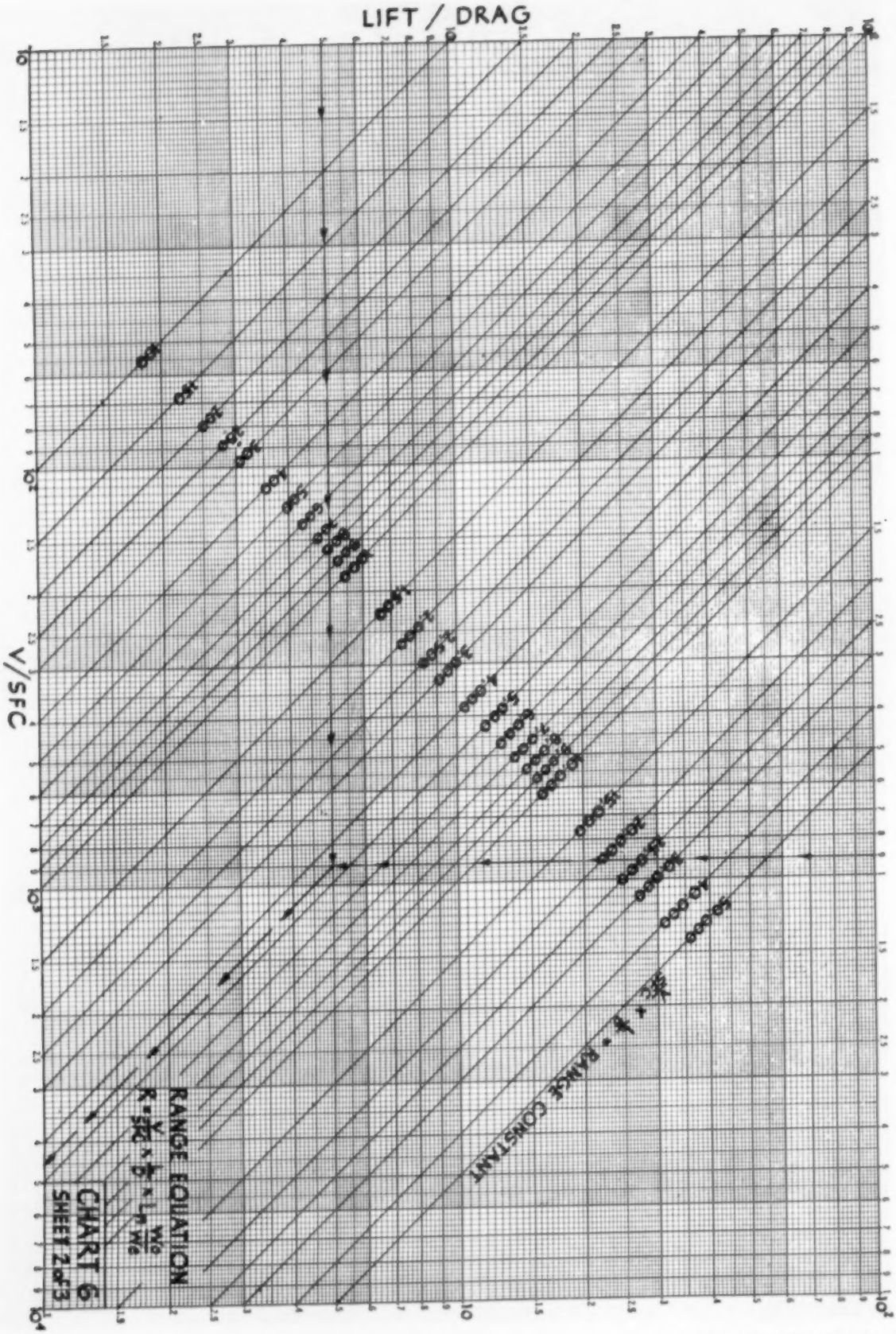
General Offices: Prudential Plaza, Chicago 1, Illinois


VELOCITY ~ KNOTS
V/SFC
SPECIFIC FUEL CONSUMPTION
RANGE EQUATION
CHART 6
SHEET 1 OF 3


LIFT / DRAG
V/SFC
RANGE CONSTANT
RANGE EQUATION
CHART 6
SHEET 2 of 3

Swedlow ACQUIRES HONEYCOMB STRUCTURES COMPANY!

Here's NEWS *of importance to you!*

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Swedlow Plastics Company is pleased to announce the recent acquisition of controlling interest in the assets, engineering and manufacturing facilities, techniques, and patents of Honeycomb Structures Company, Inc. of Los Angeles. Existing facilities will be retained, improved, and expanded.

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Swedlow aluminum honeycomb material is available in a variety of core designs, sizes & thicknesses for applications such as . . .

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Tow. Targets
Tail Assemblies
Ducting
Pressurized Tanks
Radar Vans
Microwave Reflectors
Electronic Gear Housings
Heat Exchangers
etc.

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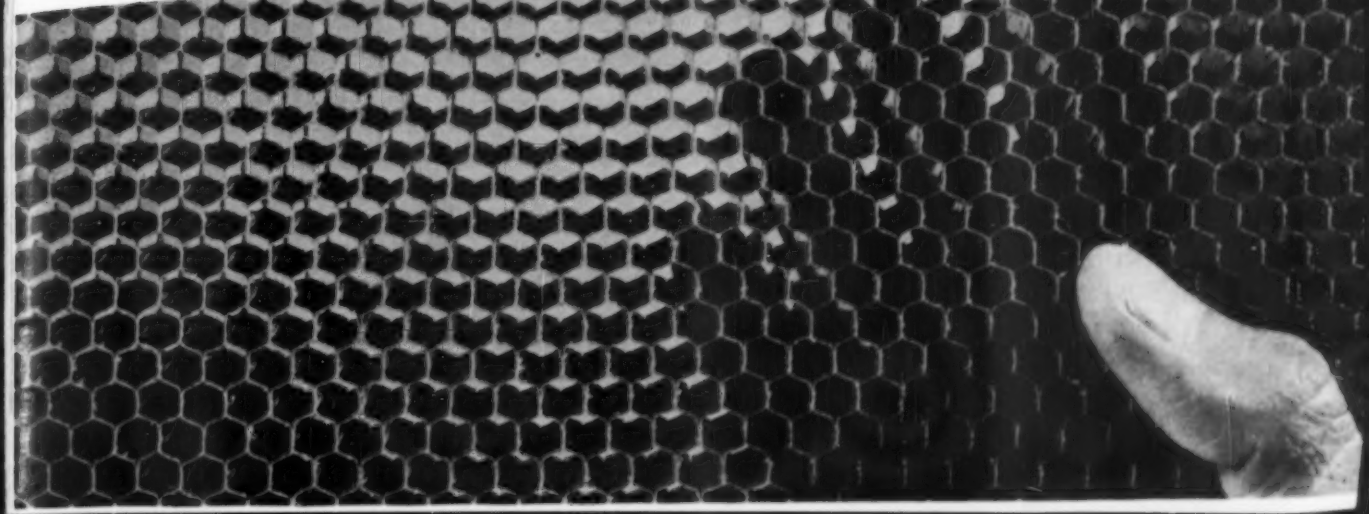
High rigidity-weight ratio
Good thermal resistance
High fatigue resistance
Good acoustical insulation
High vibration-damping properties

Swedlow
PLASTICS COMPANY

Los Angeles, California
Youngstown, Ohio
Please refer to Dept. 10



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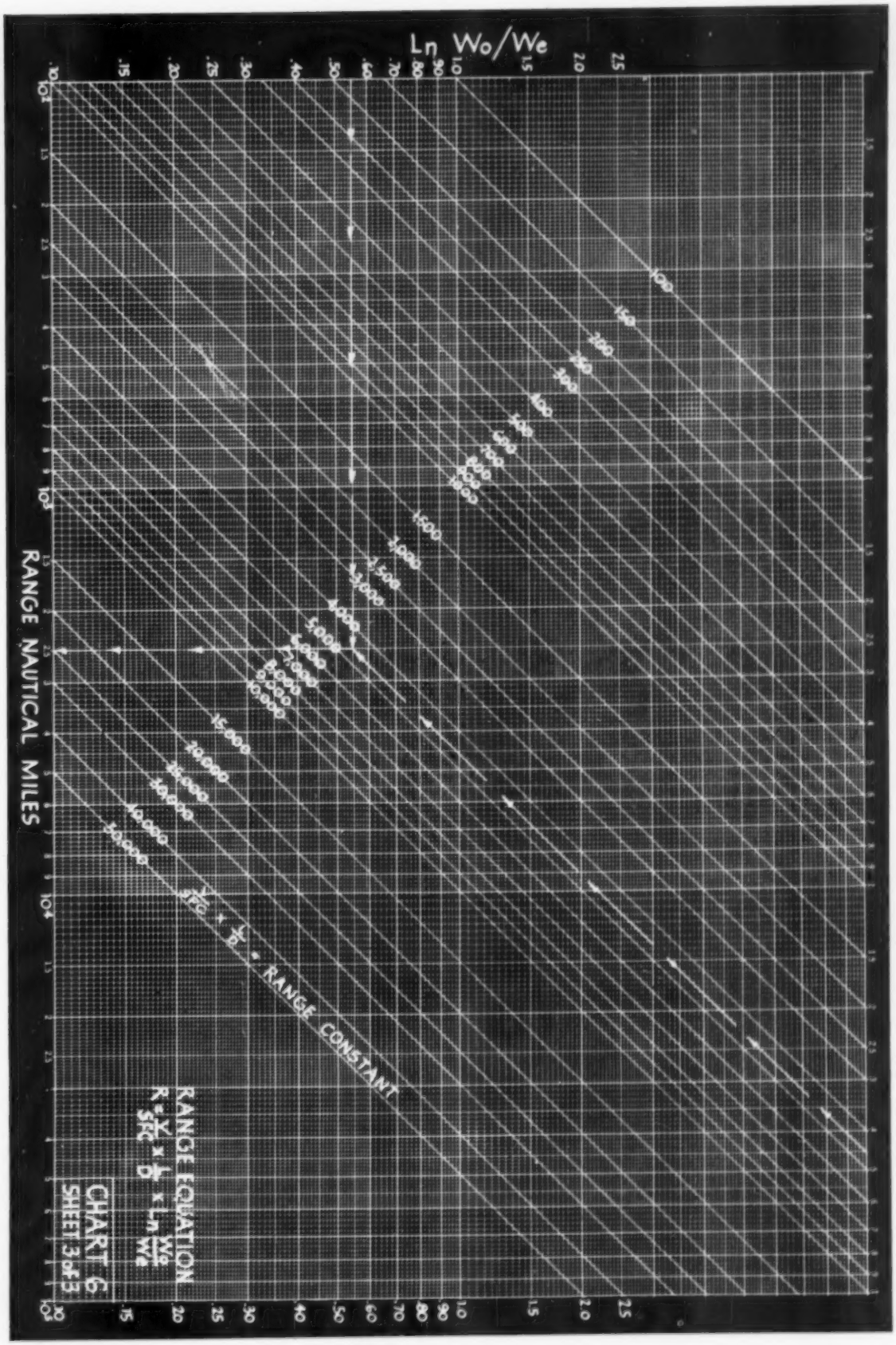
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RANGE NAUTICAL MILES
RANGE CONSTANT
RANGE EQUATION
CHART 6
SHEET 3 of 3

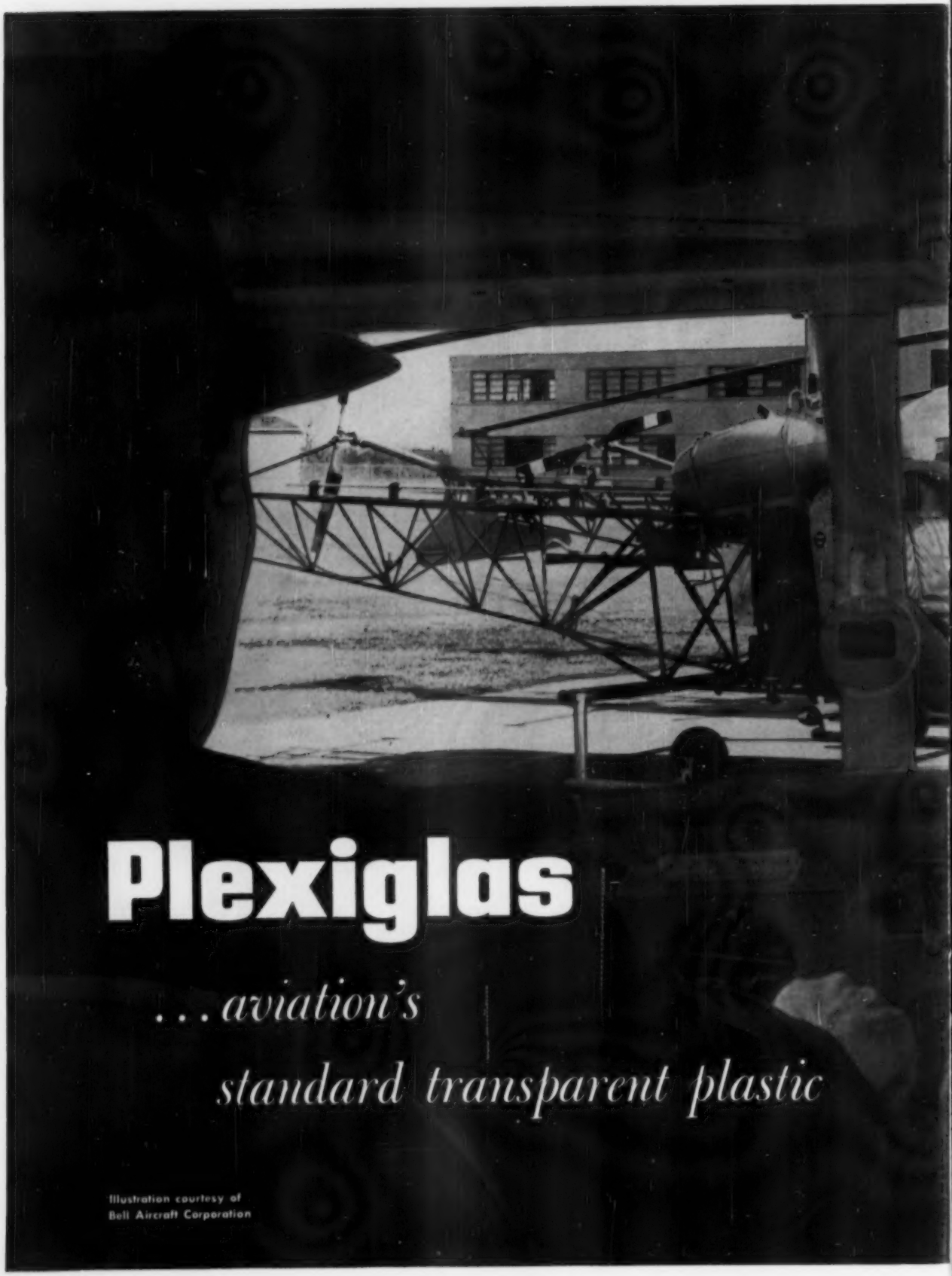
Plexiglas
. . . aviation's
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Illustration courtesy of
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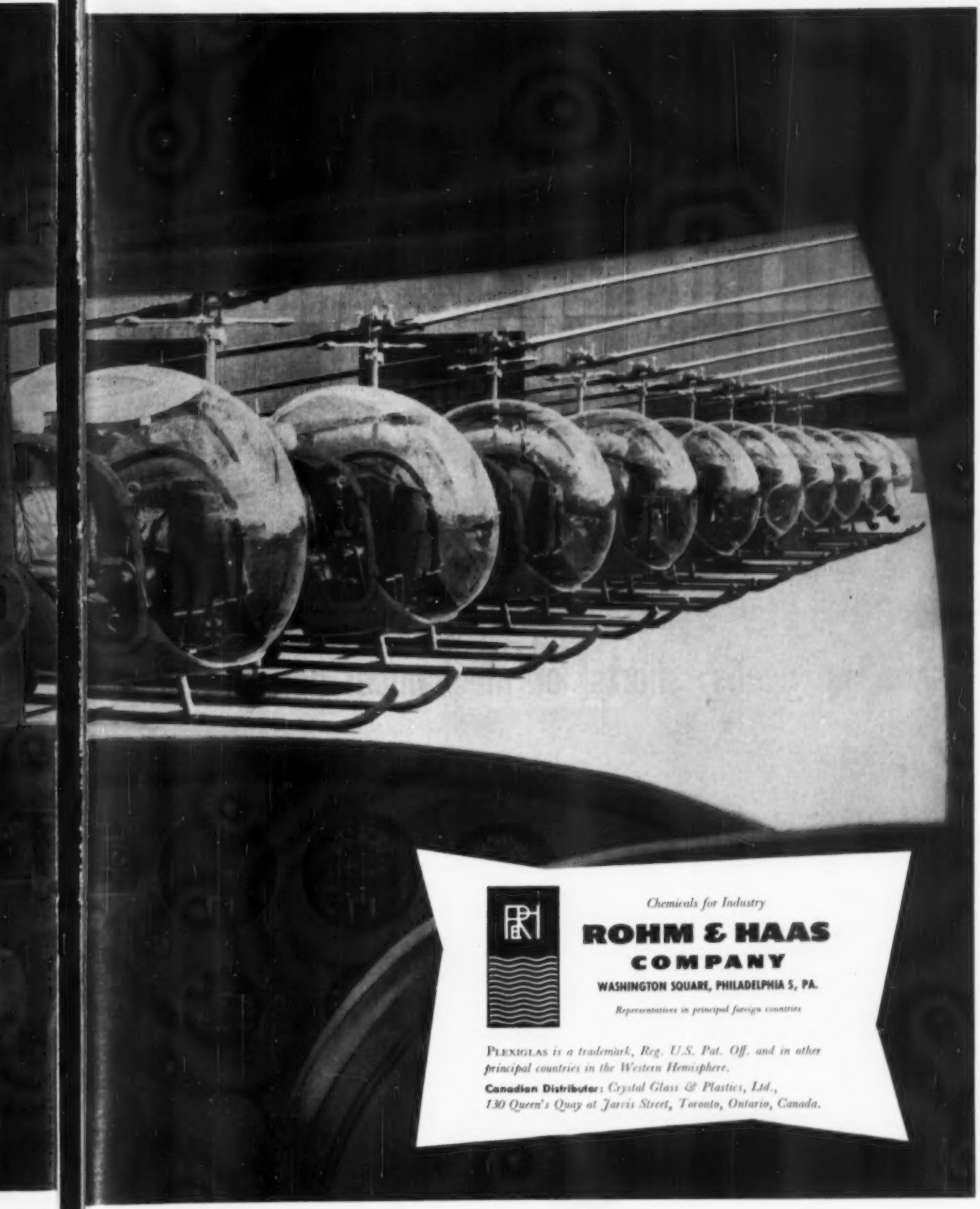

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7329 G-E 5-Star 6414 tubes in IBM SAGE computer show no opens, shorts, or mechanical defects!

AFTER 3000 hours' operation, no shorts, no opens, no mechanical defects—this describes all 7329 General Electric 5-Star 6414 tubes in IBM's first XD-1 computer for the experimental sub-sector of the USAF SAGE system.

In contrast: 17% of removals of another twin triode of earlier design tested in this giant computer, were for one of the three reasons above, any one of which can render a tube inoperative!

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General Electric helped pioneer high-reliability tubes for aviation . . . was first to design, build, and test special tubes for computers . . . later, developed the first computer types with 5-Star high-reliability performance.

The three G-E 5-Star computer tubes, and 32 G-E 5-Star types for communications and air-navigation, offer equipment-builders a choice backed by manufacturing experience not found elsewhere. Ask for a G-E tube sales representative to call! *Receiving Tube Department, General Electric Company, Owensboro, Ky.*

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102-102

B-58 Flights Taped By New Data System

Ft. Worth—Flight test data system tailored for the B-58 is helping Convair speed up the test flight schedule for the new supersonic bomber.

Convair engineers have designed a data processing system for the Hustler capable of handling data in a new, high performance flight test environment not previously encountered by bombers.

Hustler is the first bomber to use a magnetic tape recording system as the primary source of data acquisition and the first bomber to utilize a high density recording system extensively, according to William Deason, Convair engineer in charge of data processing.

Convair's B-58 data system is designed with these two aims:

- Acquire as much data as possible at the same time.
- Process and play the data back in usable form as quickly as possible.

The Victor Adding Machine Co., Chicago, Ill., designed and built the airborne and ground equipment for the system for Convair.

The Convair data installation is an analog or continuous recording system. It uses a 30 track recorder with a control panel for the flight test engineer which allows him to control it manually or set it for automatic operation.

Recorders receive signals from transducers which sense the physical variables. The transducer emits an electrical signal which goes to an oscillator, then to the magnetic tape in FM form. Tape speed is 15 inches per second.

On the ground, the playback tape transport is similar to the recording instrument in the airplane. A group of discriminators and filters recover data as originally sensed in the air.

The data comes out as a DC voltage and can be presented on strip chart recorders or oscillographs, or can be digitized and put on magnetic tape for use in computers. The data can also be put on punched cards or punched tape, or it can be tabulated in terms of decimal numbers for immediate use.

Flight test data can be processed into a form directly usable in IBM 704 type computers. Convair has two IBM 704 computers in its Ft. Worth plant.

In past years, measuring 100 variables on a flight was considered very good. The new Convair system can record up to 144 continuous test variables simultaneously on one recorder. Recorders use 1½ in. magnetic tape with 144 continuous channels.

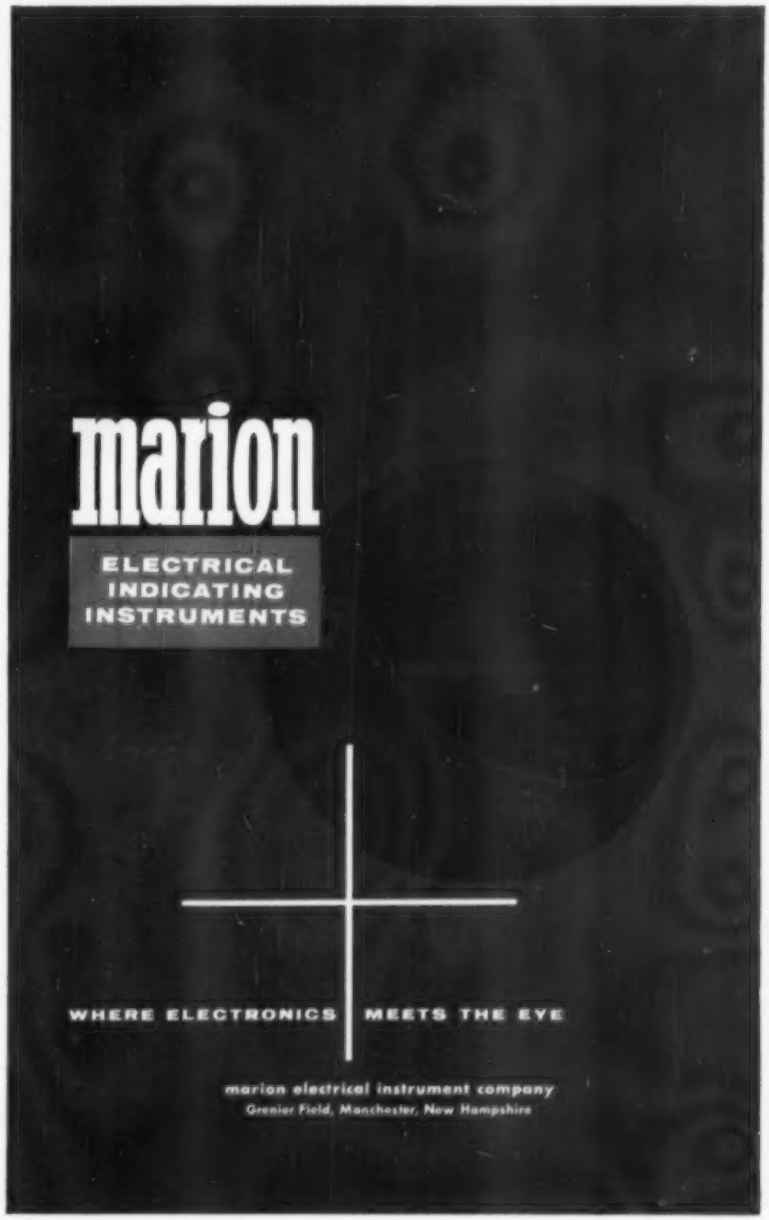
Convair usually runs at least two recorders in a B-58, and more are added for special purposes. By using commutations technique (time sharing), the system can record 200 to 300 variables on one recorder. Actually, it is capable of recording more data than any ground equipment could handle in a reasonable length of time.

The ground installation has three playback systems, all of them similar. They can be used simultaneously to play back data from as many as three flights. Three to five hours after a test flight has landed, the system can have at least the critical data in usable form for design and development engineers. This is the real test of the system, according to Deason.

The data processing group has just moved into a new flight test center where all B-58 flight test activity is under the same roof, including the hangar for flight test aircraft. The ground station is in a dust-free, temperature controlled area. It has a pressurized plenum chamber under its floor so cooling air can be brought up and ducted through the equipment.

In addition to the data gathered by the new system, a number of test variables are telemetered at the same time for expert observation on the ground. With telemetering, the pilot can be warned if any limits are approached, and a record is provided in case anything happens to the aircraft.

Convair flight test still uses the photo panel and other older methods along with the new system. Deason explains



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Poised on their launchers, the Navy's Terrier guided missiles. Official U. S. Navy photograph

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that no current single system, however sophisticated, can record all the data that design engineers want as accurately as they want it. The Convair B-58 system is better than anything to date, he says, but it is still not good enough.

Deason adds, however, that with the present equipment, it is not likely that a flight would be held up because of lack of previous data.

Convair thinks its high density data system will save valuable time in the flight test cycle of the B-58 weapon system the company is building for the Air Force. Hustler is in the YB-58 category right now; USAF has ordered 13 aircraft and plans to order another 18 in Fiscal 1958.

Convair's flight test data reduction group is responsible for all data from the experimental aircraft. The group is also responsible for a cooperative effort with range facilities for testing the weapons pod carried by the B-58.

Under the weapon system management concept used for the Hustler, Convair has complete responsibility for design and development of the bomber, and the company does its own subcontracting for systems.

The data group also works closely with manufacturers of the systems which are in the B-58.

Experimental flight testing of new aircraft has always been a time consuming and cumbersome operation, and aircraft builders and the Air Force are constantly trying to reduce the time lag between the first rollout and service status.

Flight testing is also expensive—early flights can cost as much as $50,000 an hour—so there is an economic spur to speeding up the operation and gathering as much data per flight as possible.

Up to a short time ago, flight test has been conducted with data gathering techniques in use ten years ago—photo panels, oscillographs, Brown temperature recorders. These have been improved in the past decade, but they are still limited in the number of test points, or variables, they can record in a given time. Thus, many flights are required to get the necessary data.

While it has been used in concept for ten years, telemetering is still being developed and improved. But this technique has been valuable mainly on fighters because of short flight time and space restrictions, and on missiles because most of them are not recoverable.

The smaller size and higher speed of an aircraft like the Hustler led to the need for more advanced methods of recording and processing information. Flight test in a bomber the size of the B-36 was relatively easy because its great size permitted it to carry nearly any type of recording equipment and monitors to handle it. And the long duration of flights provided time to get

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MARMAN J13 JOINT Simplifies Connection of Hot Air Bleed Lines

Lockheed's new prop-jet airliner, the Electra, is designed for simplified, efficient inspection and maintenance. Use of Marman Lightweight J13 Joints, with safety strap, on the Electra's anti-icing system combines quick connection and disconnection of bleed air lines with positive sealing at 700°F. and 125 psi.

The J13 Joint consists of a lightweight V-band coupling with flange ends for standard and thin wall tubing, fabricated entirely of stainless steel. Formed flanges eliminate need for gaskets. Marman J13 Joint is available in O.D. tube sizes from 1" to 6". Larger diameters are available on special order.

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a lot of data and to run different series of tests on the same flight.

The B-47 and B-52 were more cramped and faster than the B-36, but they still provided more space for monitoring more equipment than the B-58, the first bomber to use a high density system extensively.

Decision to use the present B-58 data gathering system was made over four years ago, and the system was designed and developed at the same time as the bomber itself. Specifications were written with the needs and capabilities of the B-58 in mind, and many components are especially designed to operate in conditions not met in slower aircraft.

Because of the environmental conditions encountered by the Hustler in its function, many components, particularly airborne parts, had to be built to exceed capabilities considered more than acceptable in the past for subsonic work.

Parts of the data system were flown in a B-36 to test the testing equipment. Then actual testing of the B-58 began with ground and taxi tests, and proceeded upward.

First flight of the new bomber was made on November 11, 1956.

With the system working to process data within a few hours, theoretically the Hustler could fly every day if there were no mechanical or weather problems.

Basically, the same data recording system is used on all B-58s in the flight test program.

Soviet Airpower Shown In May Day Parade

Bonn—German sources report the following planes were flown in the Soviet air parade over Moscow on May 1:

- 10 Bison.
- 3 squadrons Badger (Tu-16).
- 45 Bear.
- 50 Flashlight (Yak-25).
- Farmer (MiG-19).

Flader to Replace Continental Facility

Fredric Flader Div., Eaton Mfg. Co., will build a new $750,000 test laboratory in Tonawanda, N. Y., just outside Buffalo. The laboratory will contain 13,000 sq. ft. of floor space and will house complete gas turbine engine facilities, air blowing machinery, dynamometers, torque measuring apparatus, and an instrument control room.

The new facilities are being completed this year to replace the government-owned jet engine research facilities leased by Flader in Toledo, Ohio, which are being turned over to Continental Aviation and Engineering Corp., Detroit, Mich., for use in continued development of the J69 engine and a new turboprop engine being developed by Continental.

Fredric Flader, who heads the division bearing his name, was formerly chief engineer for the airplane division of Curtiss-Wright Corp.

Continental Aviation is also working on high Mach number compressors. It will use the Toledo facilities to perfect single transonic axial stage compressor which they are putting ahead of the centrifugal compressor stage on the French Turbomeca design engines to better the specific fuel consumption. Continental engineers say that a supersonic or transonic compressor is easier to handle if it is backed up by a centrifugal stage.

First German Navy Pilots Train to Fly Sea Hawks

Bonn—Twenty-five officers and cadets of the German navy are being trained as jet pilots at the Naval Air Station in Pensacola, Florida.

They will fly Sea Hawks ordered by the German naval air force and will undergo type training with British naval air forces in England.

The first Sea Hawks for the German navy squadrons will be delivered in January 1958. The total order of 68 Sea Hawks will consist of three types: fighters, radar and photo planes.

F-101B Falcon Firing Solution

Hughes Falcon missiles, partly buried in belly of McDonnell F-101B interceptor in normal flight (below), are extended and canted for firing (above). Missiles fired from belly rack otherwise tend to follow streamlines, hugging fuselage. In high velocity missile as Falcon, exhaust gases can thus be swallowed by engine, sometimes resulting in flameout. A number of jet fighters have encountered this phenomenon.

DIAGONAL SPRING EQUIFLEX

125500 Series

The new Equiflex vibration isolator pictured above is designed particularly for applications where strict adherence to Government specifications is important.

Barrel-shaped springs of heavier wire are assembled diagonally instead of radially and the result is a rugged, highly damped mount with excellent resistance to prolonged vibration at resonant frequencies. In addition to this improved performance, all the advantages of an all-metal mount with omnidirectional isolation have been retained.

SPECIAL FEATURES

- Low amplification at resonance. Approximately 2 times depending upon input amplitude.
- Resonant frequency between 15 and 20 c. p. s. depending upon mounting angle, input amplitude and location of center of gravity.
- Efficient isolation at high frequencies.
- Efficient isolation at low input amplitudes.
- All metal construction with exception of lubricant.
- Temperature range without change 375 F to −70 F.
- Vibration and shock protection characteristics unchanged by repeated shocks of 22 g's for 11 millisecond duration on all axes.
- Unharmed by hours of resonance with input of .036" double amplitude as outlined in Procedure I of MIL-E-5272A with equipment mounted both horizontally and vertically.
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Mobile Suppressor Proposed to Airlines

By George L. Christian

New York—Wheel-mounted jet engine noise suppressor for use in maintenance runup areas was proposed by The Maxim Silencer Co. at a recent Air Transport Assn. meeting in Chicago.

Proposed 15-ton mobile suppressor can be towed to a jetliner instead of requiring the plane to come to a stationary, perhaps remote installation.

Since the ATA meeting, at least three airlines—Pan American World Airways, Capital Airlines and Trans-Canada Air Lines—have expressed interest in the silencer, according to Maxim.

One Basic Design

Manufacturer contemplates building one basic design to start. It will be expandable to accommodate larger jets as they come on the market.

A Maxim spokesman made this point about the design and construction of silencers:

"The engineering problem is not so much how to accomplish absolute results as it is how to supply a workable compromise between cost, size, weight and inconvenience versus an acceptable noise level in the particular area involved.

"As a result of our experience, we believe that it is possible to provide portable or semi-portable means for jet engine intake and exhaust noise suppression within reasonable limits of cost and convenience of application . . . essentially the degree of noise reduction obtained depends on the amount of money available and/or the amount of inconvenience that can be tolerated."

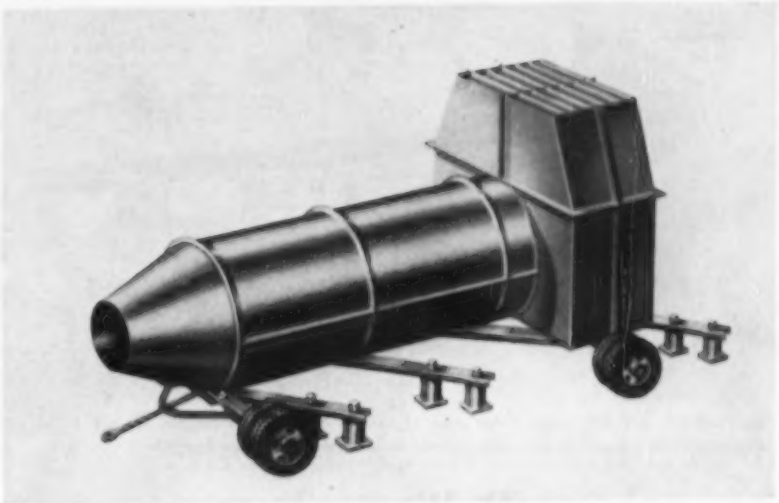
Hook-up Problem

The three basic problems of silencing jet engines mounted on aircraft are: How to quiet the engine's exhaust, how to silence its intake, and how to hook the silencers up to the engine pod of jet plane fuselage. First two problems are readily solvable, the third is not so easy.

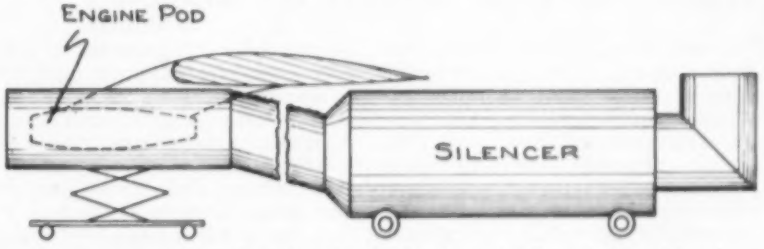
Reason for the difficulty is that a certain amount of free motion of the aircraft must be allowed for while no part of the pod or airframe may be subjected to excessive temperature or strain. Nor must excessive noise escape through the connecting mechanism.

Another problem which must be considered at the outset is how to cool the exhaust gases. Two cooling methods are induction of ambient air, and injection of a water spray. Most economical silencing design can be obtained by a compromise using both methods.

Initial silencers will be about 30-40 ft. long and cost about $30,000-$35,000.



DRAWING of Maxim's mobile, 15-ton silencer shows inlet at left, exhaust louvers at top. Jack-equipped arms under silencer are to stabilize the device.



SKETCH shows possible configuration of a mobile silencer totally enclosing a jet pod.

Design Considerations

Factors which demand special consideration in silencer design include operational and design considerations:

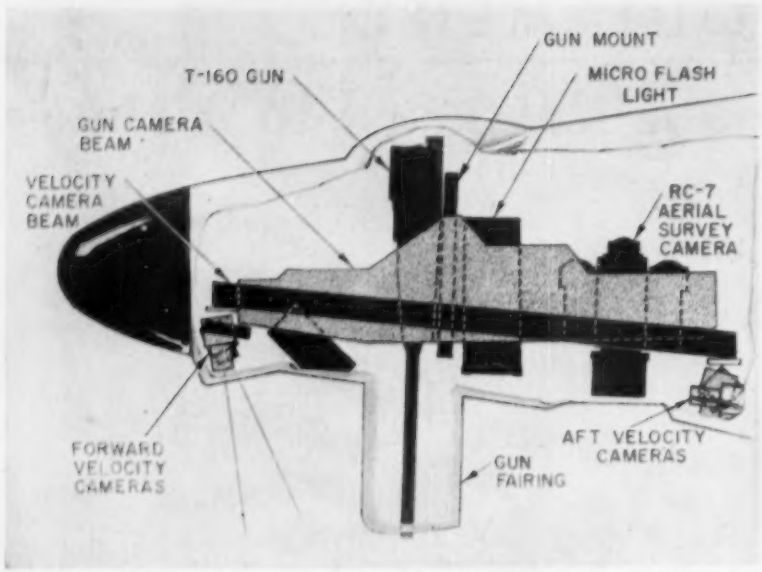
- **Afterburners,** which aggravate the design problem because of increased noise and heat. The latter requires the use of more secondary air and additional water for cooling.
- **Thrust measurement.** If the engine's thrust is to be measured during maintenance run-up, sound abatement devices must not interfere. This complicates the design problem and may indicate special connecting devices between engine exhaust and silencer.
- **Twin jet pods** create another design problem. This can be solved by designing a common intake to the silencer permitting either or both jets to operate without the complication of a valve installation and without blowback.

Design of Maxim's silencers includes a central acoustical partition made of a number of prefabricated units called acoustical logs. Ahead of this treatment are the water spray rings which not only serve as coolers but also break up low frequency sound vortices.

Design of sound attenuators must be such that exit gas velocities do not exceed 200 ft./sec. to prevent internally or externally created self-noise from reducing the effectiveness of the silencers.

Two other means of handling the ground noise problem: roll the entire plane into a roofless, acoustically-treated enclosure; or in areas where very modest noise reduction is required, direct the jet exhaust toward either blast or deflection fences.

The Maxim Silencer Co. is a subsidiary of Emhart Manufacturing Company. Address: 74 Homestead Ave., Hartford, Conn.



CUTAWAY of F-89C nose shows array of camera equipment clustered around T-160 gun. Equipment in specially-built nose is used in advanced ballistics program.

Crosswind Ballistic Testing Uses Seismic Beam System

Details of an advanced ballistics program using a specially equipped F-89C Scorpion in high speed cross-wind cannon and machine gun firing tests have been disclosed by Vitro Corp. of America. The joint Army-Air Force program was first reported in AVIATION WEEK (Jan. 14, p. 31).

Purpose of the tests is to determine the accuracy of aircraft machine guns and cannon when firing cross-wind. This, in turn, will help to determine how much flexibility can be built into the tail turret of Convair's supersonic Hustler bomber. Ballistics scientists want to obtain data to insure that projectiles fired at a side-attacking enemy, when the cannon is in a cross-wind firing condition, will find their targets when shot from such high speed aircraft as the B-58.

The complex, dynamically stable gun-camera platform, which will also accommodate M-39, T-182 or M-24A1 machine guns, also offers potential uses for other branches of the military services.

Major Problem

Typical equipment located in the specially-built, elongated F-89 nose section includes forward velocity cameras, gun and mount, microflash light, RC-7 aerial survey camera and aft velocity cameras.

A major installation problem of the gun camera platform was the requirement for the RC-7 camera to determine gun orientation during firing with an accuracy of 2.5 min. of an arc measured with respect to the earth. To accomplish this, the gun and camera had to be rigidly mounted with respect to each other and a very precise geometric relationship had to be maintained. Yet they had to be isolated from aircraft vibration and kept from responding to aircraft motion during a firing run.

Solution to the problem lay in mounting both gun and camera on a seismic mass gun beam system. It consists of a seven foot long steel beam which, with 550 lb. of lead ballast, weighs a total of 1,600 lb. The entire system is isolated from the plane's structure by four soft helical, hydraulically damped coil springs. Heavy seismic mass of the system makes it independent of aircraft motion during the short periods when the gun/camera combination is in operation. During normal flight, the system is caged, or locked, to the airframe.

Another seismic beam, weighing 560 lb., is used to support the plane's velocity camera system. Beam is made of Invar, a material with a very low coefficient of expansion to maintain the beam's critical dimensional accuracy. It is supported on four hydraulic springs.

Firing tests are conducted at night at altitudes ranging from 15,000-40,000 ft. over the ballistics range at Eglin Air Force Base, under supervision of the Ballistics Directorate of the Air Force Armament Center. Each time the F-89 passes over the range, a single projectile, containing a self-destruction time fuse, is fired downward towards the range. Almost instantaneously, four microflash cameras comprising the velocity camera system go to work. Two cameras photograph the projectile when it is four feet from the gun muzzle, two others shoot it when 16 ft. away. A fifth microflash camera, mounted on the aft end of the beam, photographs a light source at the front end of the structure to record any beam deflections during the firing which might have caused variations between the lines of sight of the four velocity cameras.

Later in its trajectory, the projectile explodes at a predetermined spot. Four ballistics cameras on the ground, whose optical axes have been determined by star fixes, record the exact points of firing and explosion. The RC-7 camera in the aircraft records the direction of firing. From these data, the projectile's trajectory is determined, giving the information necessary for firing tables.

In spite of 40,000 ft. altitudes, position of the shell will be determined within a two foot radius.

Precise Results

Other measures taken to secure the most precise results possible include:

- **Fairing around** the gun barrel to avoid any chance of its being bent by the high velocity air flow around it, since the Vulcan's cannon barrel extends 20 in. below the bottom of the fuselage. Care was taken to design the fairing to avoid any air turbulence around the gun's muzzle which would affect the projectile as it emerged.
- **Projectile velocity** measuring Doppler supplied by Raytheon radar, included in the equipment installed in the nose of the F-89. Radar's stub antenna is mounted near and parallel to the gun's barrel. Equipment is used to the projectile's velocity during initial portion of its trajectory.
- **Lights in the plane** are used to signal the position of the aircraft to the ground-based camera systems.
- **Telemetering radio transceiver** (AN/ARC-27), mounted in the nose, transmits to the ground the time of flash and round emergence pulses and controls equipment for the gun, camera, electrical and electronic systems.

Special ten foot long nose of the F-89—about one foot longer than standard—was designed and built by Thieblot Aircraft Company, a division of Vitro Corporation. Work was accomplished under contract to the Army Ordnance Corps, Ballistics Research Laboratories, Aberdeen Proving Ground, Md.

One Hole Mounting Lever Lock Switches

★ ★ ★ **Cutler-Hammer One Hole Mounting Lever Lock Switches are available in constructions to prevent inadvertent operation from any lever position to any other lever position. Intentional operation of the switch is accomplished by a pull on the lever to unlock it and permit its movement to the desired position.**

Another Cutler-Hammer "first" for Aircraft Designers

Cutler-Hammer offers the very first line of Lever Lock Switches ever engineered for one hole mounting. Lever Lock to prevent accidental operation *without* cumbersome switch guards that obstruct panel visibility. One Hole Mounting to conserve panel space and provide maximum areas for panel markings.

These are typical Cutler-Hammer Aircraft Switches . . . top-quality construction, expertly engineered. Positive snap action with dependable contact pressure in the closed position and reliably secure contacts in the open position even under the severe shock and vibration encountered in combat aircraft service. The lever seal is of special silicone rubber, engineered to outlast the operational life of the switch. The seal is unaffected by ozone or sunlight, oil or water, or extreme temperatures, either high or low.

Cutler-Hammer Lever Lock One Hole Mounting Aircraft Switches are available in single, double of four-pole constructions . . . single or double throw, with or without center "off" position. Designed for minimum parts and weight. They solve many aircraft design problems. Be sure you have complete data *now*. Write or wire today.

CUTLER-HAMMER, Inc., 1471 St. Paul Ave., Milwaukee 1, Wisconsin.

What you should know about Cutler-Hammer

Cutler-Hammer has long held the respect of the aircraft industry because this company has been *part* of the aircraft industry for 35 years. It has never been an opportunist supplier. It has *pioneered* the designs others have followed. It has sought to serve, not merely sell. It has been in the forefront of all cooperative activity in standardization and long-range planning. It has supplied complete lines of equipment, not merely the items of widest use and most profitable manufacture. Today, as for the decades past, Cutler-Hammer engineers are working closely with the aircraft industry's leaders . . . thinking ahead, planning, designing and building for the future. Here is the record:

1920 Cutler-Hammer designed and manufactured the first line of switches ever created specifically for use in aircraft.

1938 Cutler-Hammer designed and manufactured the first d-c power relays ever created specifically for use in aircraft.

1943 Cutler-Hammer designed and manufactured the first a-c power relays ever created specifically for use in aircraft.

1949 Cutler-Hammer started development of the first environment-free power relays for use in aircraft.

1953 Cutler-Hammer submitted samples and certified test reports on the first hermetically sealed power relay to WADC and Bu. Aer. Cutler-Hammer configuration was adopted as industry standard by ASG.

1955 Cutler-Hammer designed and manufactured the first one hole mounting Lever Lock aircraft switches.

CUTLER-HAMMER
AIRCRAFT CONTROL
C-H

TECHNIQUES and DEVELOPMENTS in oscillographic recording

FROM

SANBORN

RECORDING METHOD USED IN SANBORN DIRECT WRITERS, AND A REVIEW OF THEORETICAL AND ACTUAL ERROR FACTORS

Figure 1 shows the basic scheme by which Sanborn oscillographic recording galvanometers produce graphic records of electrical signal values. If the rapid deflection action of the heated ribbon tip stylus is visualized when current flows in the coil, it can be seen that a straight line at right angles to the chart length is recorded on the chart, at the point where the chart is drawn over a knife edge. The trace, therefore, is a true rectangular co-ordinate graph.

Since this is essentially a process of expressing coil (or stylus) deflection *angles* in terms of *distances* on a chart, the trigonometry of the situation (Fig. 2) must be examined to ascertain the accuracy of the method. Initially, and when θ is small, the tangent and the angle are almost equal numerically. The expression $D = R \tan \theta$ can, therefore, be rewritten $D = R\theta$ (approx.). To the extent this latter expression is true, deflection distances (rather than deflection angles) are an accurate measure of signal values. But to determine the extent of error resulting from using this approximation, the following data have been calculated*, using a chart width of 25 mm either side of zero ("D" in Fig. 2) and effective stylus length of 100 mm ("R" in Fig. 2) in the series expansion for the tangent function. Error as a function of deflection then becomes:

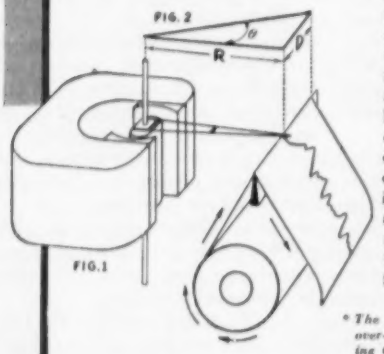


FIG. 2

FIG. 1

D mms	Radians	Theoretical Error ϵ	Corrected Error δ	Corrected Error in mms
10	.10	.0033	0	0
15	.15	.0075	.004	.06
20	.20	.0133	.010	.20
25	.25	.0209	.018	.45

When the recording system is calibrated, that calibration is often made on the basis of a one centimeter deflection from the chart center, or by means of a two centimeter deflection starting one centimeter below chart center and finishing one centimeter above chart center. In either case the deflection at one centimeter from chart center is accepted as the standard, and, therefore, is without error. The foregoing table can therefore be corrected by subtracting .0033 from each of the error terms to show the error, δ, to be expected in actual use. The final column in the table shows this error in mms.

Since the active length of the stylus increases as θ increases, deflection D increases more rapidly than θ. All positive error terms in the series expansion bear this out, but the error terms would occur as predicted only if the galvanometer produced deflections exactly proportional to coil currents (that is, ideal spring properties in the torsion rods and uniformity of magnetic field). Pole tips in Sanborn galvanometers are proportioned so that in maximum deflections, galvanometer sensitivity *decreases* slightly, the compensation resulting in *actual* linearity better than that predicted in the table.

** The mathematics involved here, as well as a discussion of fixed length stylii, design parameters affecting over-all galvanometer performance, etc., are contained in an article by Dr. Arthur Miller "Sanborn Recording Galvanometers", published in the May 1956 Sanborn RIGHT ANGLE. Copies are available on request.*

RECOGNIZE A "150" RECORD BY THESE *THREE* FEATURES...

1% Linearity

. . . resulting from use of current feedback Driver Amplifier in each channel, high torque galvanometers of new shorted coil frame design. Coil current of 10 ma develops 200,000 dyne cm torque, sensitivity is 10 ma/cm deflection.

Rectangular Coordinates

. . . save analysis time, simplify interpretation and correlation of multi-channel records. No waveform curvature, negative time lines, etc.

Permanent Inkless Traces

. . . made by hot nichrome ribbon tip of stylus on heat-sensitive Sanborn Permapaper. Clear, smudge-proof traces that clearly reveal minute signal changes.

Call on Sanborn engineers for help with your oscillographic recording application in the 0-100 cycle range. Descriptive literature is also available on request, providing data on Sanborn 1-, 2-, 4-, 6- and 8-channel Systems, choice of 12 interchangeable plug-in Preamplifiers, Separate and Supplementary Instruments.

SANBORN COMPANY
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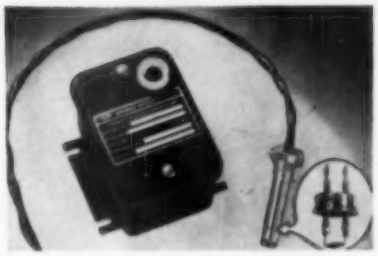
NEW AVIATION PRODUCTS



Liquid Level Sensor

Liquid level sensing system operates in liquids from 167F to −67F or their pour points, whichever is higher; in some applications liquid temperatures higher than the 167F can be handled.

Having no moving parts, equipment may be a.c. or d.c. powered and operates in any military aircraft fuel, hydraulic fluid, gas turbine lube oil, Skydrol, or other hydrocarbon liquids.

Liquified gases may also be handled by the unit.

System is capable of operating a light, a control or valves.

Simmonds Aerocessories, Inc., 105 White Plains Rd., Tarrytown, N. Y.

Miniature Selector Valve

Miniaturized four-way pneumatic selector valve Model 9905 is specifically designed for handling dry air or nitrogen in aircraft applications.

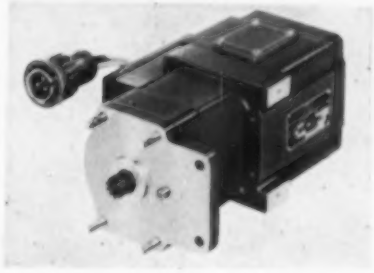
Having a forged aluminum alloy housing, unit measures three inches across opposite ports and weighs less than six ounces. Maximum internal leakage is 3 cc. per minute at room temperature and external leakage of 3 cc. per hour. Valve requires only 12 in.-lb. handle torque at full operating pressure.

Normal operating pressure is 600 psi., proof pressure is 3,750 psi. and burst pressure is 7,500 psi. Operating temperature ranges from −65F to 225F and flow factor is .033 scfm./psi. minimum and units meets MIL-P-5518-A and MIL-P-8564-A specifications.

Tactair Valve Division, Aircraft Products Co., 300 Church Rd., Bridgeport, Pa.

D.C. Motor for Missiles

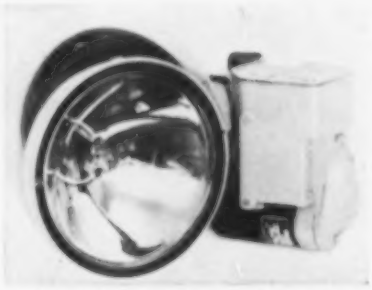
Type D-927 d.c. motor, especially designed for missile and rocket application, weighs 7.25 lb. and incorporates a 2-circuit noise filter for ungrounded systems at an additional pound. Unit's



speed is continuous at 9,900 rpm., load is 0.5 hp. and terminal voltage is 27 v., 18 amp.

Unit is designed to meet MIL-8609.

Electrical Engineering & Manufacturing Corp., 4612 W. Jefferson Blvd., Los Angeles, Calif.



Light Takes High Speeds

Retractable landing and taxi light, designed to operate at high airspeeds, is built to withstand 20G vibration and 15G shock loads, with the lamp being isolated against both.

Worm drive on the lamp arm restricts transmission of airspeed loads to the actuator. Unit is reported to meet MIL-L-8210. Lights employ 450-watt PAR 46 lamps and the circuitry is simplified to use only one relay.

Transco Products, Inc., 12210 W. Nebraska Ave., Los Angeles 25, Calif.

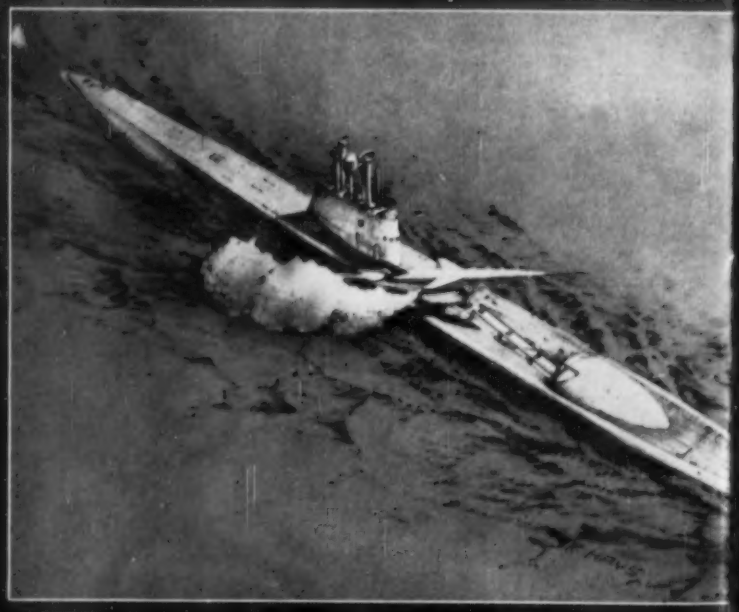
Plug-In Gate Valve

Plug-in gate valve can be removed from undrained tank without causing external leakage and obviating need for

Instrument Display Projector

Artist's drawing shows proposed use of instrument display projector developed by Autonetics division of North American Aviation, Inc. Device could be used in transport aircraft to provide last-stage instrument landing information display on pilot's windshield, in same line of sight as runway. Projector comprises cathode tube, collimating optics, trichoric combining glass using color contrast principle to strengthen definition of reflected image. Principle reduces power requirement to 4,000 volts.

VOUGHT ENGINEERS' MISSILE



SYSTEM ARMS NEWEST NUCLEAR SUB

Regulus II–Massive Air Power For Navy's "Undersea Satellite"

Construction has begun on the *USS Halibut*, world's first missile-carrying nuclear submarine. Meantime, the *Halibut's* primary weapon — Vought's Regulus II missile — is being flown repeatedly as a supersonic flight test vehicle.

Before long the two will be joined — a *true* submarine with unlimited undersea range and a far-flying missile, ready to deliver a nuclear strike. You'll hear more about this "undersea satellite" when it begins its stealthy orbit through the deep waters of the world.

Right now — as a Vought engineer — you can help bring it into being.

Chance Vought has weapon systems responsibility for mating its missile with the atomic sub. Today, Vought engineers are designing the *Halibut's* missile support equipment. They'll help train submariners for Regulus II operation, and they'll be on board for check-outs of the entire missile system.

Vought engineers introduced missile power to the Undersea Fleet with Regulus I. In the process, they traveled a new and exciting development route . . . from test range to shipyard to shakedown cruise.

Join them this time and share their adventure. Help forge from sea and air power an *ultimate* weapon.

4 IMMEDIATE OPENINGS FOR ENGINEERS

Senior Flight Test Analysis Engineer For Research Assignments. To integrate automatic computation methods into flight test data reduction and analysis methods, and to develop new methods of flight test and data analysis. Requires engineering degree and 3 to 4 years experience with flight test data reduction and analysis methods.

Propulsion Engineer. For assignment in installed turbojet and rocket performance; thermal control; inlet duct and nozzle design; aerothermodynamics.

Development Engineer. For weapon and tactical analysis. To plan optimum weapon systems prior to preliminary design, and to evaluate the military worth of new aircraft and missiles in preliminary design.

Electronic Development Instrumentation Engineer. To conceive, design, laboratory-evaluate and test intricate components and assemblies aimed at automation of data acquisition and analysis. Requires Electronics or Physics degree and 1 to 4 years experience in electronics design.

USS Halibut symbolizes advanced capabilities of the Navy's 57-year-old submarine force and signals a broad new frontier for weapon systems engineering at Chance Vought.

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Armco 17-7 PH Stainless Steel

Specified for Many Parts in Lockheed's New Electra

Unique properties of special Armco Stainless contribute to exceptional performance and economy of America's first propjet airliner

In the new Electra, Lockheed brings propjet speeds to commercial aircraft. And combining its 7 mile-a-minute performance with the traditional stamina, safety and dependability of America's airliners demanded the best of aircraft materials.

That's why Lockheed engineers have specified Armco 17-7 PH Stainless Steel for many critical parts of the Electra. Where operating conditions are severe, the unusual combination of properties offered by this special Armco Stainless meets requirements most effectively.

The high strength-weight ratios of 17-7 PH at room and elevated temperatures assure resistance to stress and heat, and its excellent fabricating characteristics simplify production.

Design and Production Advantages

Readily available in sheets, strip, plates, bars and wire, 17-7 PH, when heat treated to Condition TH 1050, has a typical room temperature tensile ultimate strength of 200,000 psi, 0.2% tensile yield strength of 180,000 psi and unusually high mechanical properties up to 900 F. On a strength-weight basis it is one of the strongest aircraft materials available.

Equally important in both design and production, 17-7 PH is easy to fabricate by standard methods. It is readily formed, drawn or welded in the annealed easy-to-work condition, then its mechanical properties are fully developed by a simple heat treatment.

Because of these unique advantages, Armco 17-7 PH Stainless Steel is being widely used in America's newest fighters, bombers, missiles and commercial aircraft. It offers you new possibilities to economically solve your design and production problems.

For complete information on the properties and fabrication of Armco 17-7 PH Stainless Steel, write to us at the address below.

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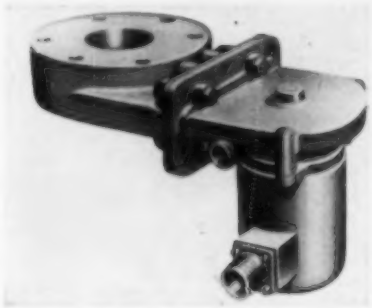
ARMCO

PIONEERING SCIENTIFIC FRONTIERS AT GENERAL MILLS

isolating the aircraft during the process, the manufacturer reports.

Housing is mounted within the tank permanently and the valve element—including motor and reduction gear



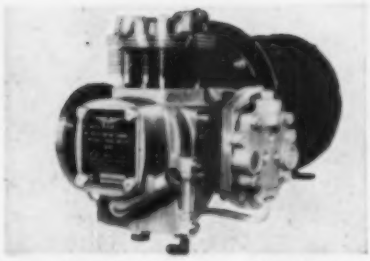
train is inserted externally into this housing. A turn of the valve element locks a secondary seal within the housing, shutting off fuel.

Wm. R. Whittaker Co., Ltd., 915 N. Citrus Ave., Los Angeles, Calif.

Pressurization Compressor

Low-pressure compressor for electronic equipment pressurization and other low-pressure pneumatic accessories consists of a three-cylinder single-stage unit combined with integral a.c. 200-v. 400-cycle electric motor. Rated capacity is six scfm. at outlet pressure of 30 psi.

Equipment is designed to operate



over range of −65 to +165F and from sea level to 50,000 ft. Oil capacity is sufficient for 100 hr. operation. Unit weighs 19.7 lb., including motor.

M. C. Manufacturing Co., Lake Orion, Mich.

WHAT'S NEW

Reports Available

The following five reports were sponsored by Arnold Engineering Development Center, Air Research and Development Command, Tullahoma, Tennessee:

On-Line Automatic Data Reduction at the Arnold Engineering Development Center—by David F. Taylor. 25 pp. (AFDC-TN-56-13)

Gas Purity of High-Temperature, High-Pressure, Electrical Discharges in Air—by Daniel E. Bloxsom. 17 pp. (AEDC-TN-56-15)

Production of High-Temperature, Moderate-Pressure Gases by Means of Electrical Spark Discharges—by Daniel E. Bloxsom. 39 pp. (AEDC-TN-56-17)

Development and Application of a High-Temperature, High-Pressure Storage Heater—by B. V. Rhodes. 30 pp. (AEDC-TN-56-18)

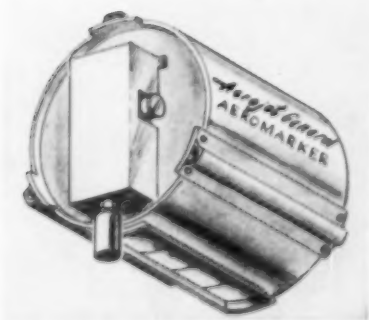
A Method of Calculating the Response Times of Pressure Measuring Systems—by Robert C. Bauer. 33 pp. (AEDC-TR-56-7)

Contributions on Partially Balanced Incomplete Block Designs with Two Associate Classes—by W. H. Clatworthy, National Bureau of Standards Applied Mathematics Series 47. $.45; 70 pp. Order from the Superintendent of Documents, Government Printing Office, Washington 25, D. C.

The following publications are available from the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C.:

A Review of the Air Force Materials Research and Development Program—by H. E. Hines and R. F. Walden, Wright Air Development Center. $2.50; 94 pp. (PB 111648-S2)

The Importance of Certain Dial



'Aeromarker' Aids Tracking

Device for visual tracking of high-speed, high-altitude targets, missiles, drones or aircraft has been developed by Aerojet-General Corp. "Aeromarker" emits flash of light and dense puff of smoke which is radar reflective and can attract infrared seekers. Multiple cartridge drum cannister, installed in target drone (above) and shown closeup (left), is one of three types of Aeromarker systems. Others are fixed unit, multiple cartridge tube launcher. All three are electrically initiated from air or ground.

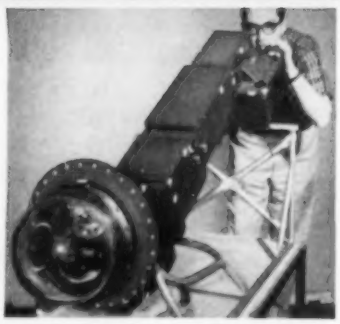
PIONEERING SCIENTIFIC FRONTIERS AT GENERAL MILLS

He's getting new basic knowledge on properties of semi-conductors

Here Dr. Rolf K. Mueller determines electrical properties of a semi-conductor specimen having a low angle grain boundary. He and his colleagues in the Electron Physics Laboratory of the Mechanical Division of General Mills grow their own pure specimens with carefully oriented crystal structures (germanium in this case). They then mount specimens very precisely for basic research involving the effect on physical properties of varying angles of junction. Variation of the angle of crystal orientation at the junction (the "grain boundary") has a predictable effect on the electrical reactions of the semi-conductor.

Semi-conductor work is but one facet of an integrated program in solid state physics. Studies of chemical, mechanical and surface properties of solid crystals and "sputtering" of metals under ion bombardment are among several other areas presently being researched in the Electron Physics Laboratory.

Some of this research is still basic, but it typifies the advanced and creative work we do. In many fields, this "research for tomorrow" is translated regularly into practical applications for industrial and military use today. If you have product or production problems, possibly you can profit from these applications and from our precision production facilities.



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MECHANICAL DIVISION

CREATIVE RESEARCH AND DEVELOPMENT + PRECISION ENGINEERING AND PRODUCTION

General Mills

Design Variables in Quantitative Instrument Reading—by J. M. Christsensen, Wright Air Development Center. $1.75; 69 pp. (PB 121119)

Recognition and Identification of Complex Visual Forms as a Function of the Labeling System Employed—by H. W. Hake and C. W. Ericksen, The John Hopkins University for Wright Air Development Center. $.75; 28 pp. (PB 121358)

Compatability of Greases—by F. S. Meade, Rock Island Arsenal Labratory, U. S. Army Ordnance Corps. $1.75; 67 pp. (PB 121737)

Climatic Extremes for Military Equipment—by N. Sissenwine and A. Court, Office of the Quartermaster General, Department of the Army. $1.75; 70 pp. (PB 121741)

Devices for Damping Mechanical Vibrations, A Bibliography—by M. Benton, Naval Research Laboratory. $2.75; 101 pp. (PB 121299)

Radiological Health Handbook—by S. Kinsman and others, Robert A. Taft Sanitary Engineering Center, Public Health Service, U. S. Department of Health, Education and Welfare. $3.75; 356 pp. (PB 121784)

Development of Subminiature High Temperature Capacitors—by Balco Research Laboratories for Wright Air Development Center. $2.00; 79 pp. (PB 111729)

Basic Research on Sintered Titanium Powder Analogous to "SAP" for High Temperature Strength—by E. P. Weber, Clevite Research Center for U. S. Navy BuAer. $1.25; 44 pp. (PB 121559)

Development of Titanium Powder Production: Final Report—by A. J. Hatch, E. P. Weber and A. D. Schwope, Clevite Research Center for Watertown Arsenal, Ordnance Corps, U. S. Army. $1.25; 44 pp. (PB 121766)

Development of Titanium Alloy Powder Production: Final Report—by H. W. Dodds and G. F. Davies, Brush Laboratories Co., Clevite Corp. $1.25; 42 pp. (PB 111918)

How To Select an Air Compressor of the Right Size and Type—Pub. by, and available from Air Compressor Research Council, 27 East Monroe, Chicago 3, Ill. $.50.

U. S. Government Research Reports—A monthly publication lists new research reports as they are released by AEC. Superintendent of Documents, U.S. Government Printing Office, Washington 25, D. C. $6.00 a year ($3.00 additional for foreign mailing).

USAF Contracts

Following is a list of unclassified contracts of $25,000 and over as released by Air Force Contracting Offices:

AF OFFICE OF SCIENTIFIC RESEARCH ARDC, Washington 25, D. C.

University of Rochester, Rochester 20, N. Y., continuation of research on "primary cosmic radiation and its interaction with matter", (AF 18(600)-380), job, $64,050.

The University of Chicago, 5801 S. Ellis Ave., Chicago, Ill., continuation of research on "The Algebraic Mechanism of Fiber Spaces", (AF 18(600)-1383), job, $35,056.

Polytechnic Institute of Brooklyn, 99 Livingston St., Brooklyn, N. Y., continuation and expansion of research on the electromagnetic theory and information processes, (AF 18(600)-1505), job, $82,901.

The Johns Hopkins University, 34th & Charles Sts., Baltimore 18, Md., continuation of research on "Boron Hydride Chemistry", (AF (600)-1526), job, $40,000.

University of Chicago, 5801 Ellis Ave., Chicago 37, Ill., continuation of research on "Semiconductors and physical electronics", (AF 18(603)-9), job, $396,650.

Armour Research Foundation of Ill., Chicago, Ill., continuation of "Research on investigation of electro-magnetic launcher for high speed projectiles" (AF 18(600)-56), job, $43,686.

President & Fellows of Harvard College, Cambridge, Mass., research on "combustion dynamics", (AF 49(638)-29), job, $40,000.

Aerojet-General Corp., Azusa, Calif., research on the interaction of burning liquid droplets and shock waves, (AF 49(638)-82), job, $29,840.

The Regents of the University of California, Berkeley 4, Calif., research on "molecular orbital correlations in organic chemistry", (AF 49(638)-105), job, $29,256.

Corvey Engineering Co., 2610 Jefferson Davis Highway, Alexandria, Va., continuation of "analytical study report", (AF 49(638)-155), job, $29,997.

Polytechnic Institute of Brooklyn, 55 Livingston St., Brooklyn 1, N. Y., analytical study of high frequency oscillatory combustion and of scaling up of rocket motors, (AF 49(638)-165), job, $31,750.

Princeton University, Princeton, N. J., continuation of research, "dielectric behavior of polar molecules", (AF 18(600)-1331), job, $29,850.

The Board of Trustees of the Leland Stanford, Jr., University, Stanford, Calif., continuation of research on "construction and use of a microwave spectroheliograph", (AF 18(603)-53), job, $183,000.

Polytechnic Institute of Brooklyn, 99 Livingston St., Brooklyn 1, N. Y., continuation of research covering "information processes", (AF 18(603)-105), job, $27,000.

University of Miami, Coral Gables, Fla., research on "studies of electronic energy bands", (AF 49(638)-62), job, $25,691.

The Regents of The University of Michigan, Ann Arbor, Mich., research on "studies in the theory of elasticity, lie groups and topology", (AF 49(638)-104), job, $26,377.

The Reactor and Visitors of the University of Virginia, Charlottesville, Va., research on nuclear interactions of 25-27 mev photons, (AF 49(638)-176), job, $41,627.

Atlantic Research Corp., 901 N. Columbus St., Alexandria, Va., research on "experimental study of turbulent flames in a two-dimensional bunsen burner", (AF 49(638)-177), job, $44,940.

Institute of Aeronautical Sciences, Inc., 2 E. 64th St., N. Y. 21, N. Y., review and analysis of aeronautical research information, (AF 49(638)-185), job, $36,850.

Massachusetts General Hospital, Boston, Mass., research on "study of behavior and performance", (AF 49(638)-98), job, $96,926.

The Regents of the University of Minnesota, Minneapolis 14, Minn., continuation of research on "high temperature research at Supersonic speeds", (AF 18(603)-16), job, $33,884.

Propulsion Research Corp., 1860 Franklin St., Santa Monica, Calif., study and evaluation of closed cycle gas turbine propulsion systems with nuclear heat source, (AF 49(638)-38), job, $91,709.

Cornell Aeronautical Lab., Inc., 4455 Genesee St., Buffalo, N. Y., continuation of wave superheater research reports, (AF 18(603)-19), job, $50,344.

Duke Univ., Durham, N. C., continuation of research on microwave and radio frequency spectrascopy, (AF 18(600)-497), job, $101,514.

Univ. of Southern Calif., Los Angeles 7, Calif., continuation of research on "interaction of shock wave and boundary layer" (AF 18(600)-1145, job, $28,390.

Smithsonian Institution, Wash. 25, D. C., continuation of research on atmospheric entry and impact of high speed meteorites, (AF 18(600)-1596), job, $31,970.

The Regents of the Univ. of Calif., Berkeley, Calif., research on "ductile ceramics" (AF 49(638)-56), job, $55,000.

The Regents of the Univ. of Calif., Berkeley, Calif., research on "effect of strain-rate on diffusion", (AF 49(638)-58), job, $27,218.

Univ. of Mich., Ann Arbor, Mich., research on "investigation of crystal defects by Electron-Spin resonance", (AF 49(638)-68), job, $85,000.

The Regents of the Univ. of Mich., Ann Arbor, Mich., research on "solid state research", (AF 49(638)-69), job, $31,423.

The Regents of the Univ. of Calif., Berkeley, Calif., research on "basic research in microwave electron tubes", (AF 49(638)-102), job, $50,000.

MOBILE AIR MATERIEL, USAF, Brookley AFB, Ala.

The Electric Storage Battery Co., Exide Industrial Div., 42 S. 15th St., Philadelphia 2, Pa., battery aircraft storage 12 volts, 88 amps (5 hour rate) hard rubber-case, compartment type cells 6 cells, 13 plates per cell, rubber separators, retainers to be of any suitable material normally used in commercial batteries standard commercial type acft vent plugs, 3,069 ea.; battery acft storage 24 V, 36 amps, spec MIL-B-6148 dtd 12 May 50, complete with disconnect receptable AF drawing 49B7292, General specification MIL-B-6146(1) Para 3.20 and para 4.48 thereof be changed from 15 CM of HG to 50 CM of HG for battery vent plub opening pressure requirement, 5,158 ea., battery acft storage 24V, 11 amps, spec MIL-B-6741 dtd 14 June 50 complete with disconnect receptacle AF drawing 49B7292, 5229 ea., AF 01(601)20280, class 03J, $79,756.

The Garrett Corp., AiResearch Mfg. Co. of Arizona Div., 402 S. 36th St., Phoenix Ariz., kit, modification for sub-assy 4939-350375-1, shaft, 1,864 ea., pawl, (3-762199), 1,119A ea., AF 01(601)20278, class 03J $265,953.

Gill Electric Mfg. Corp., 624 W. Citrus, Box 431 Redlands, Calif., battery, acft, storage, dry and charged, 24V 36 amps, spec MIL-B-6148, 5158 ea., $216,378, battery, acft storage, dry and charged, 24V, 11 amps, spec MIL-B-6741, 5229 ea., (AF 01(601)20271 class 03J), $169,994.

Grumman Aeft., Eng. Corp., Bethage, L. I., N. Y., IRAN and modification of 85 SA-16 acft. and 8 UF-1G, AF-1(601) 19950, class 01A(SA)-16, $9,743,522.

MIDDLETOWN AIR MATERIEL AREA, USAF, Olmsted FB, Pa.

Bell Aircraft Corp., Texas Div., P. O. Box 482, Forth Worth 1, Texas, iran, maintenance of H-12 type aircraft, sole source, PR MA-650807 and 650807-1, 39 ea., $241,806.

Big Three Welding Equipment Co., P. O. Box 3047, Houston 1, Tex., oxygen, liquid, PR MA-662070, 24,225,960 cu. ft., $141,460.

Dye Oxygen Co., Inc., 3332 W. McDowell Rd., P. O. Box 6276, Phoenix, Ariz., oxygen, gas, PR MA-662059, 9,449,810 cu. ft., $95,758.

Pioneer Parachute Co., Inc., 168 Forest St., Manchester, Conn., parachute, cargo, (RFP PR MA-564199), 1446 ea., $38,738.

Switlik Parachute Co., Inc., 1325 E. State St., Trenton, N. J., harness & Pack back style, (IFB PR MA-564188), 598 ea., $36,621.

Fairchild Engine & Airplane Corp., Fair-

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child Aircraft Div., Hagerstown, Md., modification of type C-123B aircraft sole source, (PR MA-540828 A-1), 90 ea., $289,927.

Jayval Co. of N. Mex. 205 Plaza, Las Vegas, N. Mex., parachute, cargo, IFB PR MA-597614, 670 ea., $116,626.

Irving Air Chute Co., Inc., 1315 Versailles Rd., Lexington, Ky., parachute assy, Harness, dirc assy, IFB PR MA-564173, 989 ea., $746,593.

Union Carbide & Carbon Corp., Linde Air Prod. Div., 30 E. 42nd St., N. Y. 17, N. Y., oxygen, gas IFB PR MA-662059, 21,749,688 cu. ft., $106,713.

DeJur Amsco Corp., 45-01 Northern Blvd., L. I. City 1, N. Y., meter IFB PR MA-651310, 273 ea., $25,935.

National Light Metals & Plastic Corp., 345 Columbia St., Caro, Mich., container assy IFB PR MA-564196, 66 ea., $58,527.

Aerial Machine & Tool Corp., 38-27 30th St., Long Island City 1, N. Y., sling, cargo IFB MIPR-R-57-1-8705-QM(07) and R-57-1-8705-QM(07)-1.

Irving Air Chute Co., Inc., 1315 Versailles Rd., Lexington, Ky., parachute assy, IFB PR MA-564166, 4232 ea., $679,662.

West-Hem Corp., 3601, S.W. 8th St., Miami 35, Fla., cylinder machine & studding assy., piston IFB PR MA-650144, 1,600 ea., $66,500.

Bachman Wholesale Co., 1073 Clinton Ave. N. Rochester, N. Y., cylinder machining and studding assy. IFB PR MA-650144, 500 ea., $48,750.

Aerodex, Inc., P. O. Box 123, Int'l Airport Branch, Miami 48, Fla., piston, IFB PR MA-650144, 2,000 ea., $27,900.

Western Engine & Supply Co., 7000 Hollywood Blvd., Hollywood 28, Calif., cylinder machining & studding assy, 10133 ea, (IFB PR MA-650144), $725,600.

OGDEN AMA, Hill AFB, Utah.

Bendix Aviation Corp., Bendix Products Div., 401 No. Bendix Dr., South Bend 20, Ind., modification kits, supporting spares and data for improvement of F100 aircraft brakes, (Request 60-554805 and 60-554847), $1,985,802.

Bendix Aviation Corp., Bendix Products Div., 401 N. Bendix Dr., South Bend 20, Ind., disc, rotating for B25 and B-26 brake, (request 60-787305), $1,810,144.

American Machine & Foundry Co., Electronics Div., 1085 Commonwealth Ave., Boston, Mass., modification kit for AN/APQ-T2A and AN/APQ-T1 trainer target altitude control and technical publication requirements, 57 kits, (Request 60-757621), $31,632.

The Massillon-Cleveland-Akron Sign Co., 681 First St., S.W., Massillon, Ohio, tow target-aerial banner 6 ft. wd. 30 ft. lg., USAF type MA-7, targets to be completed with two bar and harness, 4349 ea., (IFB 42-600-57-210), $193,617.

HEADQUARTERS, OKLAHOMA CITY, AMA, Tinker AFB, Okla.

Flight Refueling, Inc., Baltimore, Md., each set consisting of two replaceable hose and fittings and one slug to be utilized on hose assy, (RFP 183-03F-OC-732931), 1 item, $53,040.

Eastern Rotorcraft Corp., Doylestown, Pa., tiedown, cargo, (IFB 34-601-57-188-OC-726162 and OC-733048), 2 items, $332,955.

General Logistics, Subsidiary of Aeroquip Corp., Pasadena, Calif., tiedown, cargo (IFB 34-601-57-188-OC-733048), 2 items, $110,174.

ROME AF DEPOT, USAF, Griffis AFB, N. Y.

General Electric Co., Syracuse, N. Y., mock-up equipment, (AN/FRC-47 (XD-1), (RFP 30-635-57-5040Q), 1 ea., $1,827,962.

J. & H Smith Mfg. Co., Little Britain Rd., Newburgh, N. Y., antenna, AT-197()/GR (CAA), 1986 ea.; antenna, AT-197()/GR (USAF), 1300 ea.; antenna AT-197()/GR (USAF), 617 ea., (IFB 30-635-57-87H), $169,058.

Benkatron MFG Corp., 1330-1334 Utica Ave., Brooklyn, N. Y., cord-extension, (IFB 30-635-57-174B), 5147 ea., $34,962.

Pierce Wire Recorder Corp., 5500 N. Northwest Highway, Chicago, Ill., recorder-reproducer, AN/GNQ-14 (IFB 30-635-56-437B), 45 ea., $41,958.

Webcor, Inc., (Government Div.), 816 N. Kedzie Ave., Chicago, Ill., auxiliary spare parts for radar beacon AN/FPN-13 (RFP 30-635-57-4261Q), 13 group, $172,883.

Revere Electric Mfg., Inc., 6009 Broadway, Chicago, Ill., light-runway marker, specification MIL-L-7111A, Type II, Class B, part number AN 2568-7 and 2534-48, Revere number 7016 (IFB 30-635-57-185B), $10,600 ea., $318,100.

Radio Receptor Co., Inc., 240 Wythe Ave., Brooklyn, N. Y., contact guide subassy, type T-282/GR radio transmitter, 138 ea., coupler, directional type AN/GRT-3, radio transmitting set, 465 ea., fan, type AN/GRT-3, radio transmitter, 120 ea., (RFP 30-635-57-4778Q), $35,373.

SACRAMENTO AIR MATERIEL AREA, McClellan AFB, Calif.

Consolidated Diesel Electric Corp., Stamford, Conn., parts appl. to MA-1 and MA-2 MPSU (PR-2422); various quantities, $160,548.

Santa Anita Engineering Co. of Calif., 2451 E. Colorado St., Pasadena 8, Calif., stabilizer assy. (PR-7157) various quantities, $42,250.

Nemeth, Inc., 2223 S. Carmelina Ave., Los Angeles, Calif., butterfly assy-end use classified (PR-22196) various quantities, $30,400.

Consolidated Diesel Electric Corp., Ludlow & Canal St., Stamford, Conn., multipurpose servicing units for F-84, F-100, F-104, and B-57 A/C, various quantities, (PR-19789), $66,480.

T. W. and C. B. Sheridan Co., 600 W. Jackson Blvd., Chicago 6, Ill., gathering machine for collating paper in print shop, (PR-19646), $34,405.

W. P. Fuller & Co., 1725 10th St., Sacramento, Calif., plastic coating compound to coat aircraft; quantity—31973 gal; (PR-20591), $58,353.

SAN ANTONIO AIR MATERIEL AREA, USAF, Kelly AFB, Texas.

General Motors Corp., A. C. Spark Plug Div., Flint, Mich., spark plug, 4708-AC265, 540,500 ea., (PR: SA-728026 (complete) $637,790.

Land-Air Inc., 7444 Wilson Ave., Chicago 31, Ill., kit, installation of AN/APX-25 in C-25 G&H aircraft, 456 ea., (PR: SA-715863 and SA-715863-1 (complete) $120,999.

United Control Corp., 4540 Union Bay Place, Seattle 5, Wash., 9478-C-H control-humidity head sensitive type 184 to 342 ohms resist range with integral sensing, 1,285 ea., revision to overhaul instructions 13B3-2-4, 1 lot; revision to illustrated parts breakdown 13B3-2-4, 1 lot, (PR: SA-639667 and SA-639667-1 (complete) $185,479.

Grimes Mfg. Co., 515 N. Russell St., Urbana, Ohio, light assy., S/N 6220-346-6820A, 70 ea.; light assy., S/N 6220-548-6008A 73 ea.; light assy., S/N 6220-500-0736A, 298 ea., light assy., S/N 6220-NSL, 145 ea., New basic overhaul instructions with Parts breakdown. Purchase request SA-639709 (complete) $45,948.

Bendix Aviation Corp., (Red Bank Div.) Eatontown, N. J., spare parts, modification kits, components and date for aeronautical equipment. purchase request SA-639675-SFP.

Bendix Aviation Corp., (Bendix Products Div.) South Bend 20, Ind., spare parts, modification kits, components and data for aircraft fuel metering systems, purchase request SA-715947, SFP.

The Electric Auto-Lite Co., 1201 Champlain St., Toledo 1, Ohio, spark plug, S/N 4708-SH2N, 203,000 ea., (IFB 41-608-57-206, PR: SA-729003 (Complete), Job, $233,450.

Electrical Engineering & Manufacturing Corp., 1612 W. Jefferson Blvd., Los Angeles 16, Calif., aircraft accessory spare parts, 57 items; revision to overhaul handbook TO 8D1-7-10-3, 1 lot; revision to illustrated parts breakdown TO-8D1-7-10-4, 1 lot, (Applicable to items 41 and 42 only), PR: SA-715434 (complete), $227,329.

Titeflex, Inc., Handee St., Springfield 4, Mass., aircraft accessory spare parts, 33 items in support of R1300, R1340, R2600, R3350, R4360, R755 and J35 engines, PR, SA-640454 and SA 640454-1 (complete) $186,973.

Carma Mfg. Co., 1879 Mullin Ave., Tor-

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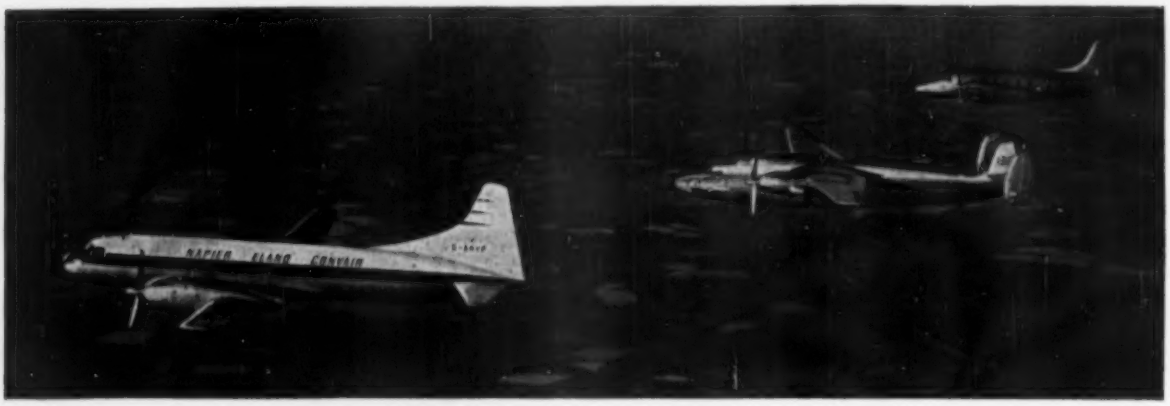

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rance, Calif., actuator, S/N 9449-10691, PR: SA-639718 (complete), 240 ea., $56,848.

Electrical Engineering & Manufacturing Corp., 4612 W. Jefferson Blvd., Los Angeles 16, Calif., aircraft accessory spare parts, 5 items, reissue of overhaul instructions with parts breakdown to 8D1-17-20-3, 1 lot; deissue of overhaul instructions with parts breakdown TO 8D1-15-4-13, 1 lot, PR: SA-715456 (complete), $67,740.

Air Associates, Inc., Teterboro, N. J., aircraft accessory spare parts, items 1 thru 62, (PR: SA-715435 and SA-715441 (complete), $47,696.

Technical Constructors, Inc., P. O. Box 2488, Dallas, Tex., addition and modification to existing test cells Nos. 57 and 58 and control room, bldg 652, (IFB-41-608-57-212, PR: ID-2293 (complete), $141,593.

SHELBY AIR FORCE DEPOT, Wilkins AF Station, Shelby, Ohio.

Recony Corp., 150 Nassau St., N. Y. 38, N. Y., air conditioners type MA-3, 182 ea., $2,226,271, air conditioners type MA-3, 19 ea., $245,100, engineering data, $1,840 specif or item, 1 lot, $3,150, (PR MH-654935, 698982), total $2,476,362.

United States Rubber Co., 1 Market St., Passaic, N. J., hose U. S. Rubber P/N, 4750 ea., (RFP 33-602-57-3055), $52,640.

Boeing Airplane Co., Seattle Div., P. O. Box 3707, Seattle 24, Wash., rubber, special shaped section law Boeing P/N's, 264940 ft., (RFP 33-602-57-3062), $28,911.

Welded Construction Engineering Co., 2037 W. 14th St., Cleveland 13, Ohio, maintenance platform acft type B1, 1026 ea., $461,700, maint data, 1 set, $3,500, maint platform 86 ea., $38,700, (IFB 33-602-56-306), total $503,900.

Lockley Machine Co., 310-322 Grove St., New Castle, Pa., towbar-acft NW type 203 ea., $49,978, engineering data, 1 set, $320, (IFB 33-602-57-73), total $50,298.

B. F. Goodrich Aviation Products, Div. of the B. F. Goodrich Co., 500 South Main St., Akron 18, Ohio, hose, aircraft, (IFB 33-602-57-122), 225800 Ft., $112,286.

TOPEKA AIR FORCE DEPOT, Topeka Air Force Sta., Topeka, Kan.

Sprague Engineering Corp., 19300 S. Vermont Ave., Gardena, Calif., stand, test, aircraft hydraulic system, 10 ea., technical data (handbooks) for above, lot, $90,636, (RFP 14-604-57-4430)

Linair Aviation, Inc., Ash at Regent, Inglewood, Calif., elbow, 190,000 ea., reducer-tube, 12,300 ea., $32,075. (IFB 14-604-57-580)

Greer Hydraulics, Inc., N. Y. Int'l Airport, Jamaica 30, N. Y., stand, propeller governor, 135 ea., technical data for above, lot, engineering data for above, lot, $1,214,-874, (RFP 14-604-57-5261)

Aviation Developments, Inc., 210 S. Victory Blvd., Burbank, Calif., pin-quick release, 19600 ea., $259,040, (RFP's 14-604-57-5341, 5342, 5343, 5347, 5349, 5360).

Aluminum Co. of America, 1200 Ring Bldg., Washington 6, D. C. aluminum alloy tubing, 24000 pounds, (IFB 14-604-57-639), $27,229.

Arnolt Corp., Aeronautical Div., 2261 S. Carmelia Ave., Los Angeles 64, Calif., 12 items for gasoline engine system, 184 ea.; pintle assy, 184 ea.; stand, test acft, hydraulic system, 184 ea., (IFB 14-604-57-229), $237,012 (Increase).

Delco Chemicals, Inc., 2700 S. Eastern Ave., Los Angeles 22, Calif., cleaning compound, 440100 lbs, (IFB 14-604-5-324), $42,-396 (Increase).

General Motors Corp., Allison Div., Aeroproducts Operating branch, Municipal Airport, Dayton 1, Ohio, 20 items of special tools and equipment for C-119 acft for a total of 535 pcs. 318 ea., (RFP 14-604-57-5194), $110,967.

Adel Precision Products, Div. of General Metals Corp., 1444 Washington Ave., Huntington 4, W. Va., clip, 1,080,000 ea., (IFB 14-604-57-593), $107,293.

National Lock Co., 1902 7th St., Rockford, Ill., bolt, 396,000 ea., (IFB 14-604-57-611), $26,518.

Kaiser Aluminum & Chemical Sales, Inc., 919 N. Michigan Ave., Chicago 11, Ill., aluminum alloy sheet, 290,400 lbs, (IFB 14-604-57-510), $301,975.

AMC Contracts

Wright-Patterson AFB, Ohio—Following is a list of unclassified contracts for $25,000 and over as released by the Air Materiel Command:

McDonnell Aircraft Corp., St. Louis, Mo., flight-test program for F-101B acft, (PR PH-638883), $23,259,600.

Color Corp. of America, Houston-Rearless Div., 11801 W. Olympic Blvd., Los Angeles 64, Calif., modification kit for the A-9 photo processor, 280 ea., time compliance technical order, 1 set, (PR MO-735934 and Amendments 1 and 2), $64,577.

General Electric Co., Aircraft Turbine Div., Cincinnati 15, Ohio, 1947 product improvement program for J79 and J47/J73 turbojet engines, (PR PE-7-02A-3090), $10,000,000.

Family Films, Inc., 5823 Santa Monica Blvd., Hollywood 38, Calif., 16mm, black and white motion picture prints, 477 ea., 16 mm, black and white motion picture prints, 212 ea., (PR 669993), $51,076.

General Electric Co., Erie, Pa., generators, A.C., oil cooled (Aerno 42-6101) for F-106 acft, regulators, A.C., (Aerno 42-6102) for F-106 acft, panels, A.C. control (Aerno 42-6103) for F-106 acft, generators, D.C., oil cooled (Aerno 42-6100) for F-106 acft, panels, D.C. (Aerno 42-61111) for F-106 acft, spare parts, MT & TE, engineering and maintenance data for F-106 acft, (PR PE-694362), $1,649,494.

General Electric Co., 1000 Western Ave., West Lynn, Mass., transmitter, rate of flow, fuel, type MB-3, Aerno 61-2474, used on KC-135A acft, power supply, type MC-1, Aerno 61-1051, used on KC-135A acft, (PR 603641 and 603596), $600,394.

Lear, Inc., 110 Ionia Ave., North West, Grand Rapids 2, Mich., indicator, altitude, remote, type MM-2 for F101B, F102A,

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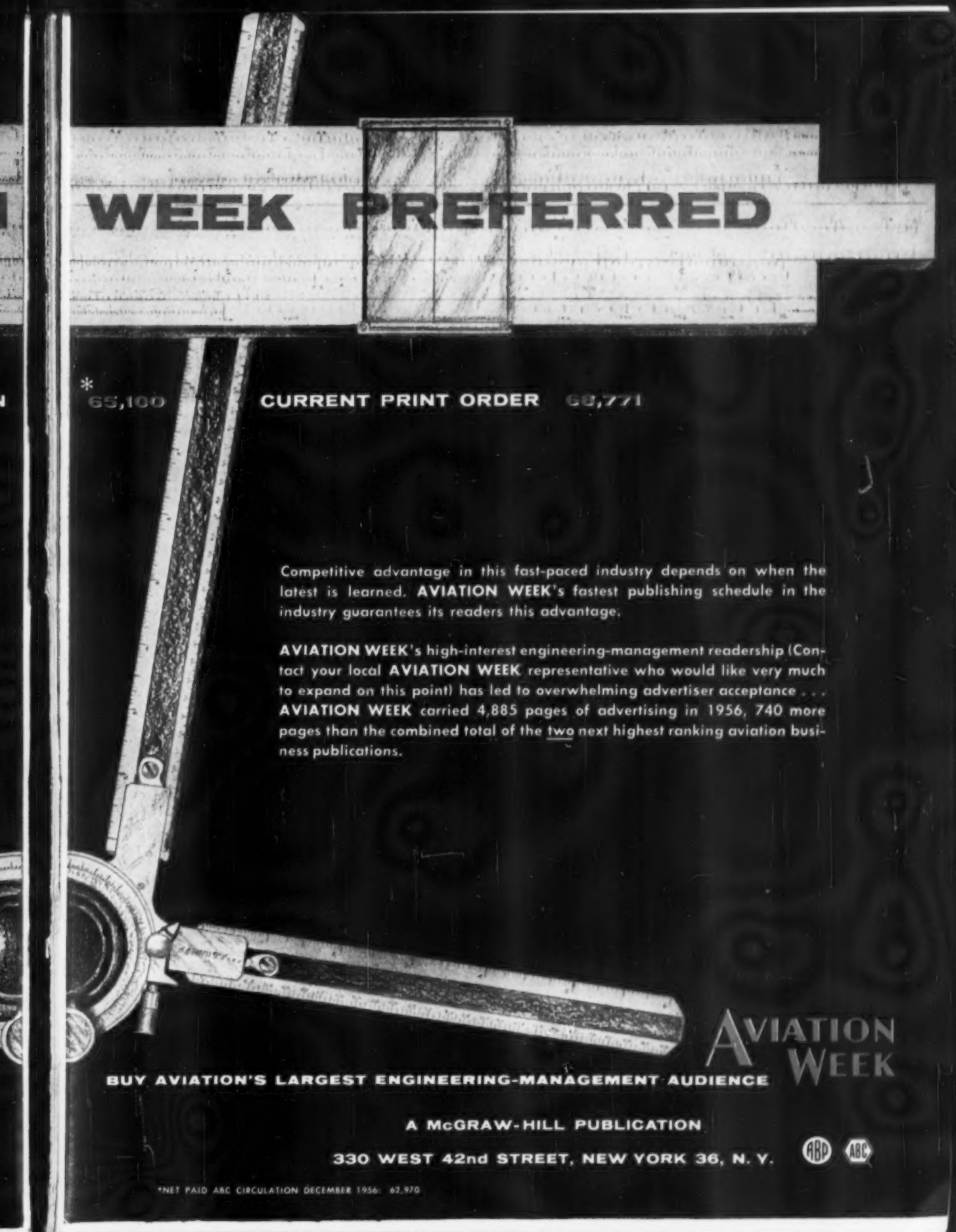
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Air Refueling Gains Versatility

North American F-100 is added to list of aircraft capable of using Buddy refueling system. First inflight refueling (above) of one F-100 by another was made with Flight Refueling, Inc. probe and drogue system for which all F-100Cs and Ds will be equipped. Conversion of Boeing KC-97 tanker boom to probe and drogue system adds to flexibility of USAF air-to-air replenishment (below). Douglas B-66 is being refueled.

F-104A, and F-105B acft. control, roll and pitch, type K-4B for F-101B, F-102B, F-104A, and F-105B acft. (PR 603603, 603-557, 692136, and 537274), $2,556,750.

AiResearch Mfg. Co., of Arizona, Div. of The Garrett Corp., Phoenix, Ariz., starters, pneumatic, acft engine, type STU-1/A, Aerno 42-9409, (PR PE-604311), $1,004,500.

Abrams Instrument Corp., 600-620 E. Shiawassee, Lansing, Mich., type B-8B intervalometers used in various types of aircraft, engineering data used in various types of acft, (PR MO-736388), $414,402.

Avco Mfg. Corp., Lycoming Div., 652 Oliver St., Williamsport, Pa., 0-435-6 acft engines, (MIPR R57-1036-34-AER), $118,-800.

Curtiss-Wright Corp., Propeller Div., Caldwell, N. J., material and services to cover product improvement for C-133 aircraft, (PR PE-7-03A-3053), $464,000.

Douglas Aircraft Co., Inc., P. O. Box 200, 3855 Lakewood Blvd., Long Beach, Calif., 4 AC power system operable trainer to supplement MTU's RB-66B-1,-2,-4 and B-66B-3, (PR PH-604508), $262,280.

The Glenn L. Martin Co., Baltimore 3, Md., incorporation of miscellaneous CCN's B-57 series acft; also procurement of engineering data, B-57E series acft (PR PH-54811), $83,942.

Lockheed Aircraft Corp., Marietta, Ga., modification of twenty (20) and storage of forty-two (42) C-130A airplanes, (PR PH-205029), $13,995.

Kollsman Instrument Corp., Standard Coil Products Co., Inc., 80-08 45th Ave., Elmhurst, N. Y., N. Y., type ME-5 machnumber indicators for F-100 acft, (PR PE-708087), $187,960.

Bendix Products Div., Bendix Aviation Corp., 401, Bendix Dr., South Bend 20, Ind., brake assy, main (for 30x8.8 wheel), (PR PE-564308), $1,016,469.

Oakland Aircraft Engine Service, Inc., Oakland Airport, Oakland, Calif., overhaul of R-2800-79 aircraft engines, (PR SA-560140-2), $63,112.

Aircraft Gear Div., Dana Corp., Fort Wayne, Ind., preparing government-owned property for shipment, (PR PB-7-S-6035), $467,660.

Kollsman Instrument Corp., Standard Coil Products Co., Inc., 80-08 45th Ave., Elmhurst, N. Y., type K-3 sensitive indicators for aircraft, (PR OC-705355 and OC-705356), $114,132.

Transco Products, Inc., 12210 Nebraska Ave., Los Angeles 25, Calif., antenna, AT-720/A, 932 ea., (PR 7-16K1-3050), $63,126.

Aerosonic Instrument Corp., Hercules and Range Rd., Clearwater, Fla., type MA-2 cabin air pressure indicators for the B-52D and KC-135A, (PR PE-708073), $34,947.

The Morse Instrument Co., 21 Clinton St., Hudson, Ohio, timer, interval electrical automatic photo type C-1B, (PR MO-735859), $47,409.

Chicago Aerial Industries, Inc., 1980 Hawthorne Ave., Melrose Park, Ill., B-1 computer, LA-20 converter, LA-18 detector, (PR 736397, 564655, 736387, 736375, 564-656), $66,409.

Standard Coil Products Co., Inc., Kollsman Instrument Corp., 80-08 45th Ave., Elmhurst, N. Y., type ME-4 airspeed, machnumber and maximum allowable speed indicator for the F-101B, F-102A, F-104A and F-104B, (PR 537274, 603558 and 603574); $442,034.

Bill Jack Scientific Instrument Co., Solana Beach, Calif., cable harness assys, for UCCS component, (PR MO-736451), $31,066.

Ampex Corp., Suite 204,3898 Linden Ave., Dayton 3, Ohio, tape recorder, playback equipment, rack-mounted for tape recorder, (PR 652267, 642268, 642277 and 642278), $185,243.

General Electric Co., 1 River Rd., Schenectady, N. Y., automatic flight control system type AN/ASW-10 for F-105B, F-105C acft, (PR 604389 and Amend 1), $1,000,000.

North American Aviation Inc., Los Angeles Int'l Airport, Los Angeles 45, Calif., modification of F-100C-3 mobile training unit to F-100C airplane configuration and modification of F-100C-4 to the F-100C/D-4 model aircraft configurations, (PR 603512), $428,058.

North American Aviation, Inc., Los Angeles International Airport, Los Angeles 45, Calif., modification of Government furnished F-100C aircraft, for use by the Air Force demonstration team, (PR 177875), $44,256.

Northrop Aircraft, Inc., Hawthorne, Calif., modify Government furnished F-89-6 mobile trainer unit, (PR PH-633874 and PH-633869), $296,644.

Giddings & Lewis Machine Tool Co., 142 Doty St., Fond du Lac, Wis., numerical director systems, auxiliary test equipment and performance and acceptance tests, (PR 709578-1), $614,511.

Fairchild Engine & Airplane Corp., Fairchild Aircraft Div., St. Augustine Branch Plant, St. Augustine, Fla., IRAN maintenance and modification of B-26 type acft, (PR SB-554270), $200,000.

International Telephone & Telegraph Corp., 67 Broad St., N. Y. 1, N. Y., a tropospheric scatter communication system between Spain and North Africa with installation, maintenance and logistic support, (PR PM-7-S-5044), $215,000.

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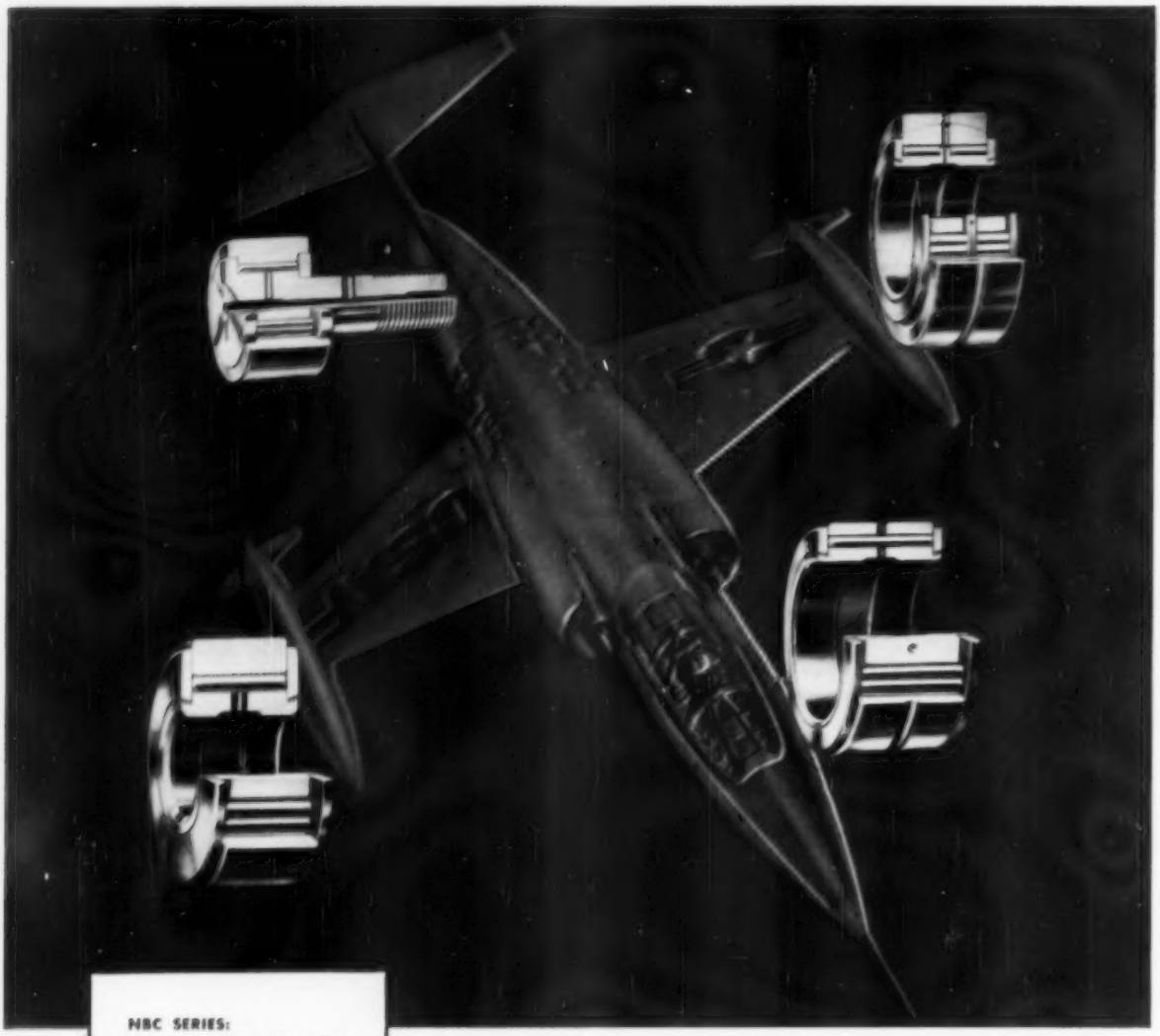

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GENERAL AVIATION Facilities Planning group map is used to depict air traffic volume during typical busy week.

Curtis Told Business Flying Will Boom

By Erwin J. Bulban

Washington—U. S. business aircraft will generate more than five billion passenger-miles in 1976, approximately one-quarter of all first-class air and rail transportation in the 100 to 1,000-mile range, General Aviation Facilities Planning Group has reported to Edward P. Curtis, special assistant to President Eisenhower for aviation facilities planning.

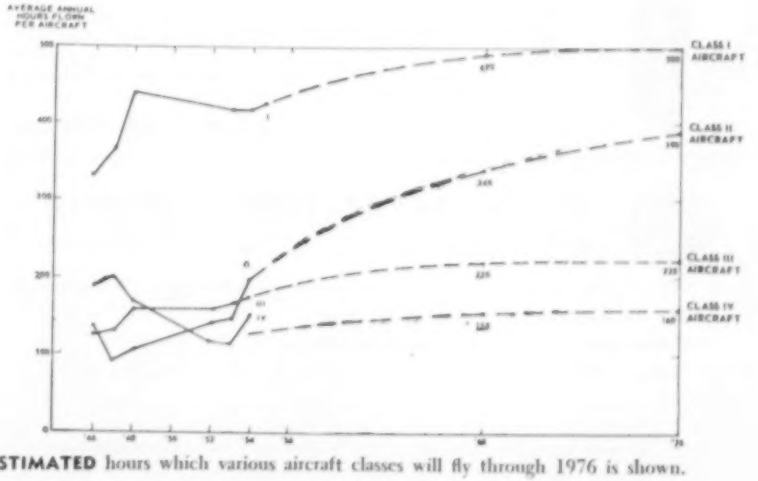
GAFPG also forecasts that in another 20 years, there will be some 90,000 privately owned aircraft active, flying about 20 million hours annually compared to approximately 65,000 planes now being utilized over 10 million annual hours.

558,000 Movements

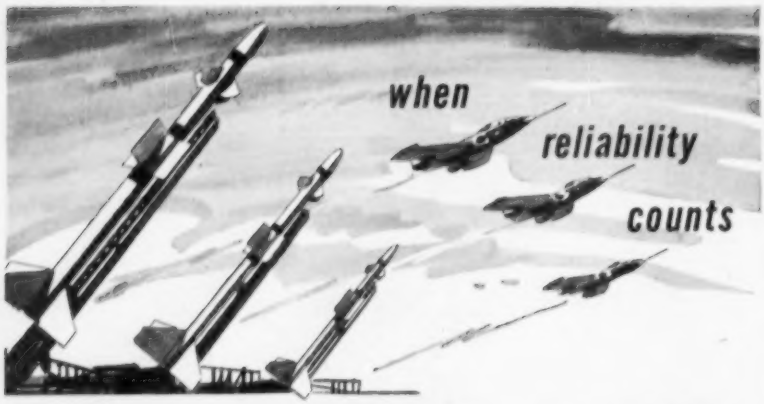
Operational load that this growing general aviation fleet—covering all flying except military and airlines—will place on U. S. aviation facilities in 1976 include an estimated 558,000 landings and takeoffs on a peak week-day. Current peak private plane traffic generates some 380,000 landings and takeoffs on a single day.

Latest Civil Aeronautics Administration data on air traffic tends to confirm the steadily rising share of movements by general aviation category planes: last year this group accounted for 45% of the total of 22,046,000 landings and takeoffs reported by CAA towers. Of the 817,000 instrument approaches handled by the Federal Airways System last year, only 9% were made by general aircraft. But this group showed a 51% increase in such landings over 1955, the largest increase of any of the other segments of U. S. aviation.

General aviation IFR peak demand will increase substantially by 1976, GAFPG indicates. With new electronic equipment developments and installations supporting IFR operations, this incidence will spread across the total general aviation fleet, bringing new aircraft into the instrument operations category from the lower types. It is estimated that by 1976 there will be an increase of five to eight times the



ESTIMATED hours which various aircraft classes will fly through 1976 is shown.



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RCA Type 206W1—A 2 PDT miniaturized DC relay weighing less than 0.9 ounces. Temperature Range —65° C to +125° C. Like the 204W1 uses a "getter" to keep contacts clean. All other characteristics the same as the 203W2 except resistance to vibration shock from 5 to 2,000 cps is 15g.

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Estimated Fleet Composition in 1966 and 1976

Aircraft Class	1966 Range	1976 Range
I	2,100– 2,500	3,000– 4,000
II	4,400– 6,500	8,000– 10,000
III	35,000–40,000	45,000– 56,000
IV	28,500–31,000	24,000– 30,000
Total . .	70,000–80,000	80,000–100,000

General Aviation Facilities Planning Group Survey

present IFR peak load generated by general aviation planes.

Delving into the characteristics of future general aviation aircraft and their equipment, the GAFPG report contains conservative prognostications, based on checks with manufacturers. As regards airframes, GAFPG broke general aviation planes into five categories for identification purposes:

- **Class I** comprises large multi-engine planes having a total rated horsepower from all engines exceeding 750 hp. Such planes currently range from the Convair-Liner to the Beech 18.
- **Class II** are light-twin types having a total power rating of 750 hp. or less, as represented by the Piper Apache through the Beech 50 Twin-Bonanza.
- **Class III** are single-engine three-or more-place types ranging from the Piper Tri-Pacer through the Beech 35 Bonanza.
- **Class IV** comprises single engine airplanes seating one or two.
- **Class V** covers the helicopter category.

With these characteristics in mind, the GAFPG report to Mr. Curtis states that only a modest number of turbojet-powered aircraft will be produced by 1976, although there will be some Class I jet-powered planes operating in the next five years. It expects that within the next 20 years the majority of Class I aircraft will be turboprop-powered, with significant numbers of piston-powered planes still operating in the total general aviation fleet.

No Class II Turbojets

There are expected to be no turbojet-powered Class II airplanes in this period because present-day specifications and preliminary design work on twin-jet airplanes indicate that all such aircraft will be in a weight and power size which will move them into Class I. By 1976 most Class II planes will be turboprop-powered, but there will still be many piston-powered planes in this category.

Class III will have a wide range of operating characteristics, with a trend

Performance by Aircraft Class—1956-1966-1976

Class of Airplane	Cruising Speed (mph)			Stalling Speed (mph)			Gross Weight (Pounds)			Take-off over a 50-Foot Obstacle (Feet)		
	1956	1966	1976	1956	1966	1976	1956	1966	1976	1956	1966	1976
I (Large multiengine)												
Maximum	315	500	600	100	100	100	50,000			4,700	4,500	4,500
Minimum	180	220	230	85	65	50	9,300	8,000	6,500	1,540	1,300	1,000
II (Light twin)												
Maximum	210	280	350	70	65	60	6,300	7,000	7,500	1,400	1,400	1,400
Minimum	150	150	150	52	48	45	3,100	3,000	3,000	1,000	900	800
III (Single engine, 3 place or more)												
Maximum	190	220	250	57	55	50	3,000	3,500	5,000	1,650	1,500	1,400
Minimum (b)	100	115	125	49	45	35	1,800	1,800	1,800	900	750	600
IV (Single engine, 1 or 2 place)												
Maximum (c)	130	180	220	45	45	50	2,000	2,800	3,500	1,000	1,100	1,200
Minimum	90	90	90	38	35	35	800	800	800	600	600	500
V (Helicopters)												
Maximum	140	180	200				33,000	33,000	33,000			
Minimum	60	60	70				2,300	2,400	2,500(d)			

Class of Airplane	Range (Miles)			Service Ceiling (Feet)			Rate of Climb Feet/Minute		
	1956	1966	1976	1956	1966	1976	1956	1966	1976
I (Large multiengine)									
Maximum	3,000	3,200	3,500	30,000	35,000	45,000	2,500	3,000	6,000
Minimum	1,100	1,000	1,000	23,000	24,000	25,000	1,500	1,500	1,500
II (Light Twin)									
Maximum	1,300	1,400	1,600	22,000	25,000	28,000	3,000	3,400	3,700
Minimum	750	750	750	18 500	18 000	18 000	1 200	1 300	1 500
III (Single engine, 3 place or more)									
Maximum	1,000	1,000	1,000	20,000	26,000	28,000	1,300	1,800	3,000
Minimum (b)	410	400	400	12,500	13,500	15,000	700	700	800
IV (Single engine, 1 or 2 place)									
Maximum (c)	550	700	1,000	19,000	26,000	28,000	1,000	1,400	2,600
Minimum	350	350	350	12,800	13,000	15,000	400	600	700
V (Helicopters)									
Maximum	500	500	600						
Minimum	90	150	200						

(a) Take-off over a 50-foot obstacle equivalent to some landing measurements.
(b) Does not include Custer Channel Wing, Helio Courier, etc.
(c) Maximum excluding dusters, sprayers, etc.
(d) Two place enclosed model.

General Aviation Facilities Planning Group Survey

Instrument, Communication and Navigation Equipment—1956

Per Cent of Aircraft Equipped with Each

Aircraft Class	Instruments for CAA IFR Conditions	Radio Receiver	Radio Transmitter	Auto Pilot	Manual Direction Finder	Automatic Direction Finder	VOR	DME	ILS Localizer	ILS Glide Slope	Airborne Radar
I	100	100	100	39	15	72	87	2	67	55	5
II	86	100	100	19	10	62	81	—	57	10	5
III	58	91	91	7	16	23	51	—	18	3	—
IV	20	64	54	3	9	5	14	—	4	—	—

* Indicates less than .5% of aircraft reported such equipment

Source: Aircraft Owners' Survey.

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toward turboprop power, and with perhaps some single-engine jet types in insignificant numbers.

Class IV planes will be powered by small turboprop and piston engines, with a great number of the aircraft produced for training and pleasure. A significant number of high-performance one-and-two-place aircraft with larger engines will also appear by 1976.

Future of Class V types, which include VTOL steep gradient as well as helicopters is difficult to forecast, according to GAFPG, because initial price and operating costs still loom as important restrictive factors and it is difficult to determine rate of progress that will be made in overcoming these handicaps toward widespread acceptance.

Equipment manufacturers, particularly in the electronic category, appear to have a bright future in the growth of general aviation. Currently, the large multi-engine fleet is fully equipped for IFR operations and more than 80% of the smaller twin-engine and over half of the single-engine private planes of three or more places are similarly fitted.

Proportion of Class II, III and IV airplanes that will be equipped with IFR instrumentation will increase modestly in ratio to their current utilization. There will be a tendency for all airplanes, except for a few used only for local flying, to have two-way radio. An increase in proportion of planes fitted with autopilots will increase substantially in all four classes.

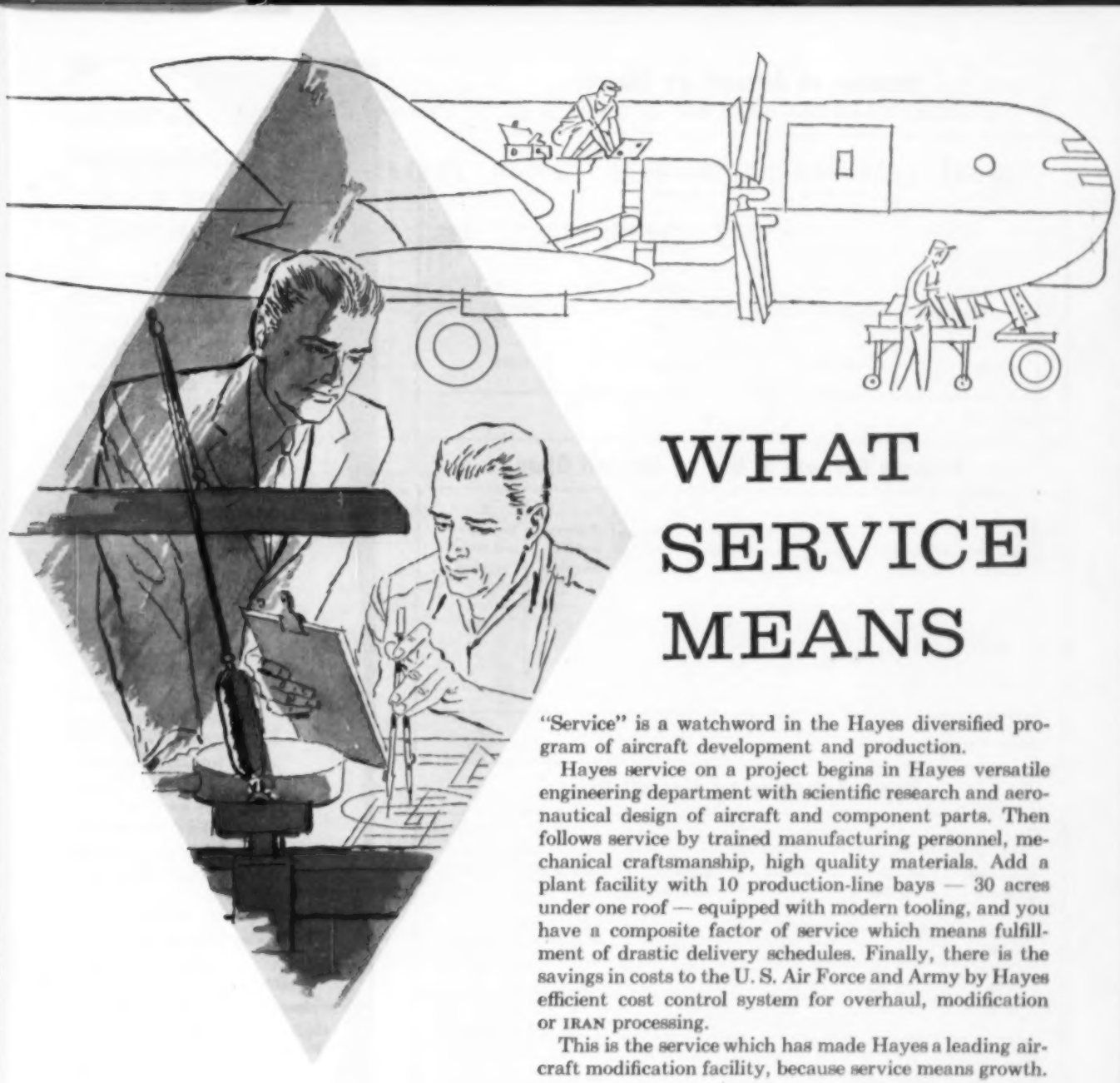
New Equipment

Both manual and automatic direction finders in their present general configuration and prices appear to have reached their saturation point in the general aviation field, the report states, with new equipment of the combined direction finding and distance measuring type reducing the need for conventional DF equipment.

Increasing quantities of VOR or improved direction finding devices will be used by general aviation and the report states that an economical distance measuring combination would have great appeal to this market. Increased use of ILS localizer and glide slope equipment is also seen.

Today's general aviation plane owners have an investment of some $100 million in auxiliary equipment, GAFPG conservatively estimates, on the basis of replacement cost.

The group's breakdown of the current general aviation fleet puts the number of aircraft used primarily for business transportation at 23,000; by adding those aircraft used for air taxi, charter and cargo the number comes to about 34,000 planes. These make up the major portion of Class I and Class II aircraft and about two-thirds of



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Number of Aircraft by Classes

(As of Jan. 1, 1956)

Aircraft Class	Certificated Airworthy	Registered Aircraft	Inactive Aircraft
I	1,630	1,909	279
II	1,525	2,204	679
III	22,545	27,326	4,781
IV	31,623	48,513	16,890
V	256	306	50
Totals.....	57,579	80,258	22,679

Source: CAA

Primary Purpose of Use by Aircraft Class

Aircraft Class	No. of Airworthy Aircraft	Business Transportation	Passenger and Cargo for Hire	Patrol and Survey	Personal and Non-Business	Instruction and Miscellaneous
I & II	3,160	70%	17%	1%	10%	2%
III	22,550	56	6	1	32	5
IV	31,600	26	4	1	52	17
V	260	7	14	43	36	

Source: Aircraft owners survey.

Type of Owners by Aircraft Class

Aircraft Class	No. of Airworthy Aircraft	Company	Business (Aviation)	Individual	Club
I	1,630	43%	24%	33%	*%
II	1,530	45	30	25	*
III	22,550	21	10	67	2
IV	21,600	4	21	72	3

* Less than 0.5%

Source: Aircraft owners survey.

Class II types. Another 24,000 planes are used for non-business purposes. They are comprised primarily of Class III and Class IV types.

A shifting usage of general aviation aircraft will result in substantial revision of the general aircraft fleet by plane class, according to the report. Increasing proportion of the fleet will be in Class I and II aircraft with some increase in the ratio of Class III planes. The proportion of Class IV aircraft is expected to drop sharply in view of increased numbers of higher performance planes and a shift of owners from Class IV types to Class III in the lower performance ranges.

Another factor tending to increase the overall general aviation fleet is the steadily increasing income of U. S. families. Marketing analysts consider a median annual income of $25,000 as a measurement for an airplane prospect; GAFPG researchers state that in 20 years there will be some 350,000 families in this income bracket and of the age level to encourage an interest in owning an airplane.

Increase in numbers, utilization and performance characteristics of general aviation aircraft will have a profound impact upon aviation facilities, particularly since there is a marked tendency for airplanes to be based in the more

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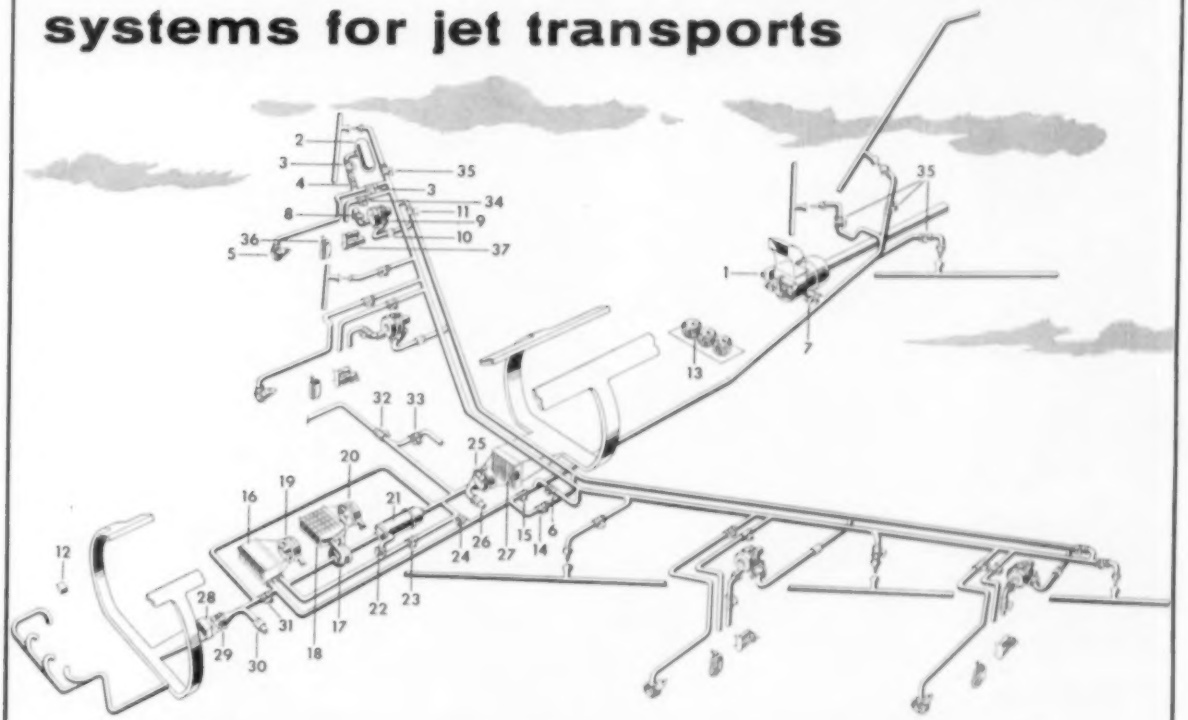

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Forecast of Traffic Density at Selected Large Hubs in 1976

Hub Name	Estimated Number of Operations on Peak Day of Typical Busy Week	
	1956	1976
Los Angeles	21,100	29,000
New York	12,900	19,500
Chicago	12,600	18,900
Dallas	4,700	7,500
Miami	4,200	6,500
Seattle-Tacoma	4,000	4,900
Denver	2,600	3,800

General Aviation Facilities Planning Group Survey

populated areas, which also comprise air traffic hubs generating the majority of all aerial traffic.

More than 60% of the total general aviation fleet is based in 10% of the counties in the U. S. Flying likewise is concentrated in population centers; GAFPG estimates that 60% of general aviation operations occur in hub areas. As an example, the report notes that the Chicago hub area has 30 airports.

Although there is a considerable amount of cross-country flying from hubs, most hub flying is local in character, and this pattern is expected to continue.

For a typical busy hub area, such as Chicago, indications are that the hourly peak will still occur in midafternoon 20 years from now, with 460 aircraft being aloft at 3 p.m. But increased usage of larger numbers of business planes will tend to stretch out the peak to provide a high rate of air activity from 9

Curtis Assumptions

Following assumptions were accepted as established criteria by Edward P. Curtis's aviation facilities planning advisors in developing forecasting requirements over the next decade:

- No global war to occur, but continuance of international tension with periodic local incidents.
- U. S. continues vulnerable to enemy attack.
- Defense expenditures will be maintained at a level between $30 billion-$40 billion in 1955 dollars by 1975.
- Population increasing to about 210 million-220 million by 1975.
- Gross national product increasing to about $715 billion-$740 billion in 1955 dollars by 1975.

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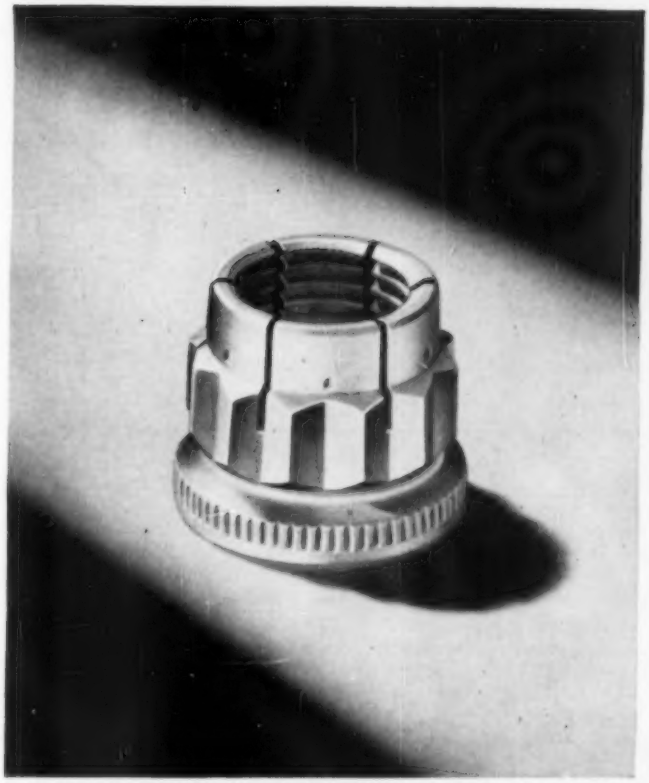

NEW SPS 119 FW self-locking nut is made of corrosion and heat-resistant alloys, silver plated. It incorporates the reliable SPS FLEXLOC self-locking feature, which locks the nut securely in place without auxiliary locking devices. These nuts are precision manufactured to Class 3B fit.

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SPECIFICATIONS

Size	A ±.010	H ±.005	W max	W min
10-32	.375	.350	.313	.304
¼-28	.438	.406	.376	.367
5/16-24	.531	.468	.439	.430
⅜-24	.593	.500	.502	.492
7/16-20	.687	.570	.564	.553
½-20	.781	.604	.627	.616

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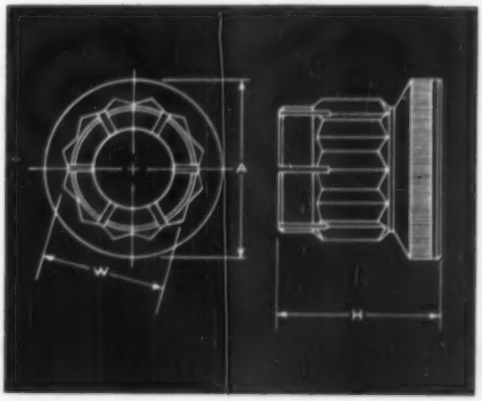

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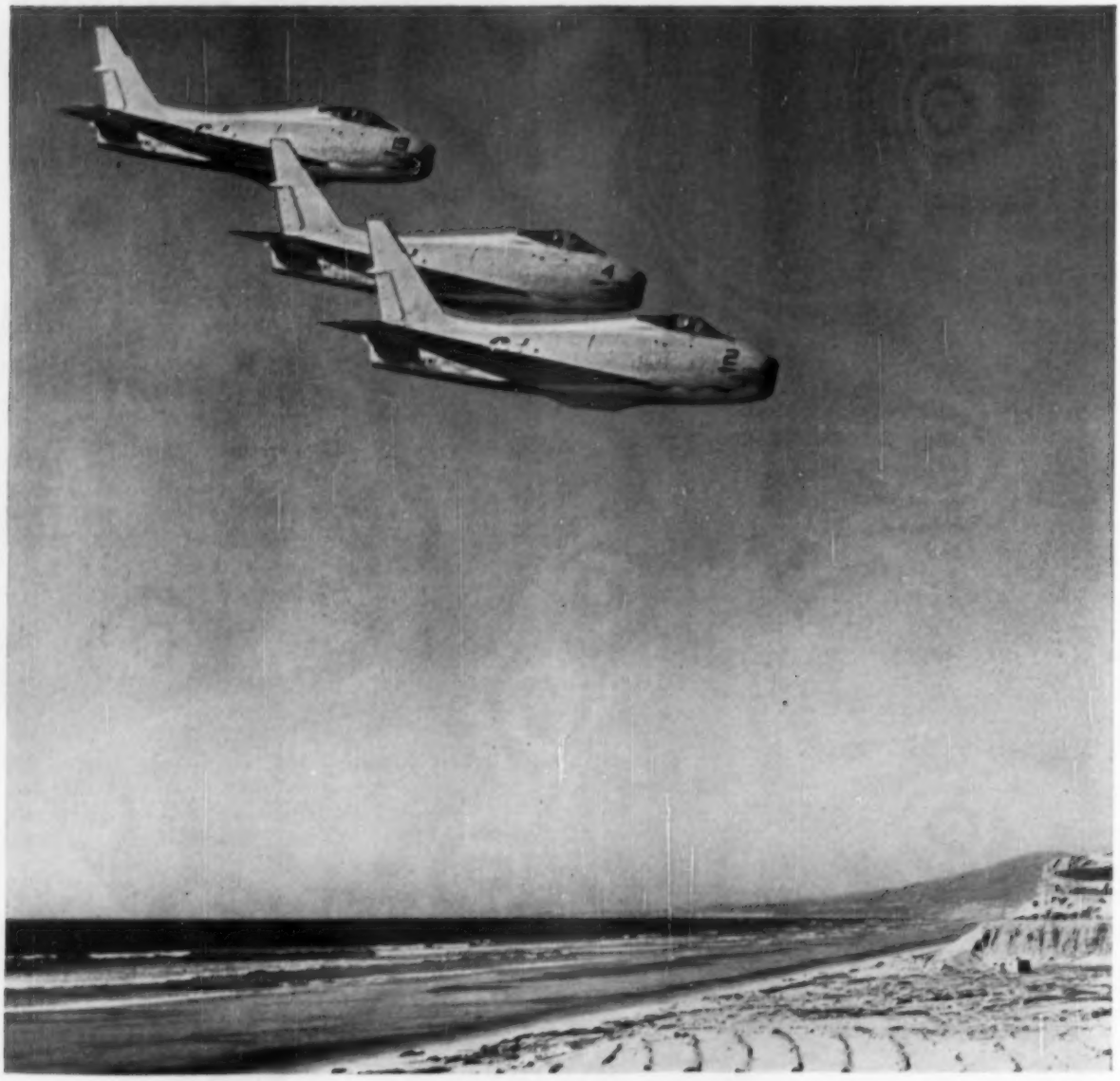

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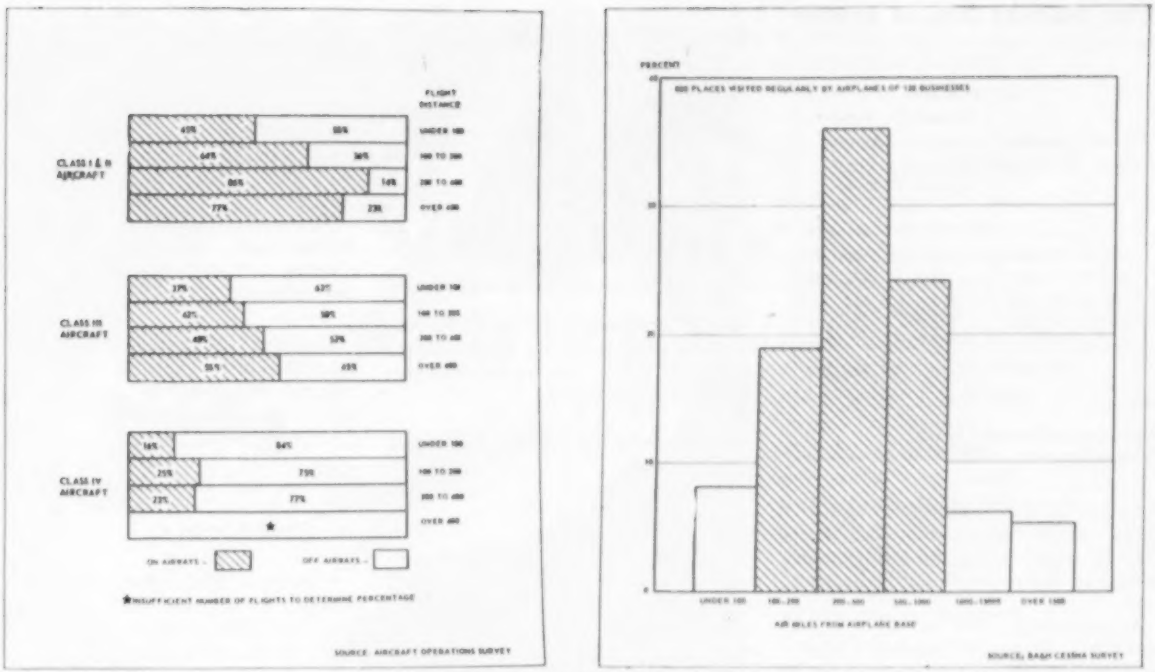

ON-AIRWAYS FLIGHT are compared with off-airways traffic (left). Distance from base of business plane destinations is graphed at right.

a.m. to 5 p.m. Stretching this peak aggravates traffic control loads considerably since there is less margin in which the peak loads can be shifted, especially in the case of business aircraft which maintain schedules.

Peak airport activity was found by GAFPG researchers to come in the July, August or September, with little variation from region to region. Variations in operations throughout the week is also similar across the country, with loads building up toward the end of the week, and Sunday the busiest day.

In a two-day period last October, more than 2,000 GAFPG volunteers on some 600 "guinea pig" airports across the country recorded essential facts on some 100,000 individual general aviation takeoffs and landings. Extrapolation of this data showed that the approximately 380,000 operations by general aviation planes on a typical peak day could be broken down as follows:

- **Large hubs,** 116,000 operations, 30% of the total.
- **Medium and small hubs,** 109,000 operations, 29% of operations.
- **Non-hub airports,** 155,000 operations, 41% of operations.

Further breakdown of this survey, covering the busy Chicago hub area on a typical Friday and Saturday shows that 8,670 operations were handled the first day and 12,600 landings and takeoffs were handled on the second day. Peak hour is about 3 p.m.

Heavy percentages of local flying at the 28 airports comprising the Chicago hub area point up the problems facing traffic planners studying general aviation operations.

On Friday, a total of 2,780 aircraft stayed within the vicinity of a hub area airport, 80 ventured a little further and 192 stayed within the hub area; 413 planes ventured cross-country. Saturday, 5,711 aircraft stayed in the vicinity of a hub airport, 238 went a longer distance and 192 remained in the hub area; 609 went cross-country.

Study of other hub area operations shows that this pattern of heavy local versus cross-country flying is maintained across the country, with some 85%-90% of hub activity comprising the former.

Heavy local flying is expected to continue at least through the 1976 period, the report to Mr. Curtis indicates, with some 60% of the aircraft on a peak day in a typical hub remaining within the hub area for most of its flight time in the future.

Although Class I and Class II aircraft do a considerable amount of cross-country work—83% of the aircraft in Classes I and II were said by their owners to fly over 75% of the time cross-country—total fleet size of the smaller Class III and IV types is so large that they make up the greatest share of general aviation planes in this type of flying. The report notes that most cross-country flights are less than 200 miles, based on distance to the next landing point rather than total trip distance. Average distance of cross-country flying is expected to remain the same through 1976, with some increase by the larger Class I aircraft. The report states that this is based on the assumption that the places to be visited, rather than the performance characteristics of the aircraft determine trip length.

Data furnished to Mr. Curtis by GAFPG indicates that the capabilities of the Class I and Class II aircraft are

Local Versus Cross-Country Operations at Selected Hubs

Operations on Peak Days of a Typical Busy Week

	Local	Cross-Country
Chicago	90%	10%
Dallas	85	15
Fort Worth	86	14
San Francisco	85	15
Kansas City	90	10
San Diego	95	5
Tulsa	87	13
Miami	94	6
San Antonio	93	7
Des Moines	80	20
Range	80%-95%	5%-20%

Source: Aircraft Operations Survey
Airport Operators' Survey

Flying Hours by Class of Aircraft

Aircraft Class	Number of Aircraft	Average Annual Hours Flown per Aircraft	Total Annual Hours Flown
I	1,630	445	725,000
II	1,525	225	343,000
III	22,545	195	4,392,000
IV	31,623	146	4,620,000
	57,579		10,080,000

Source: Aircraft Owners' Survey

supported by the qualifications of their pilots, which substantiates the belief that the bigger and faster multi-engine aircraft are the ones getting the heaviest use.

Approximately 60% of the Class I and Class II general aviation aircraft pilots have instrument ratings; the trend reverses in the case of Class III and Class IV planes, where 60% of the pilots hold only private pilot tickets, with relatively few instrument ratings held by either private or commercial pilots of these aircraft classes.

Interesting point is that some 58% of Class III planes have IFR capability, indicating that the performance of the airplanes outstrips the capability of their pilots, leaving a large field for instruction facilities to develop.

PRIVATE LINES

USAF designation for its 80 Cessna 310 light twins is L-27A. First military models are flying, with initial deliveries planned for this month.

Piper Apache No. 1,000 was delivered to Dr. and Mrs. T. J. Gamble, Encino, Calif. late last month. First Apache delivery was made April 1954.

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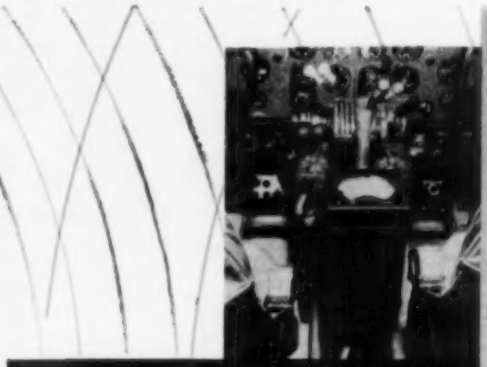

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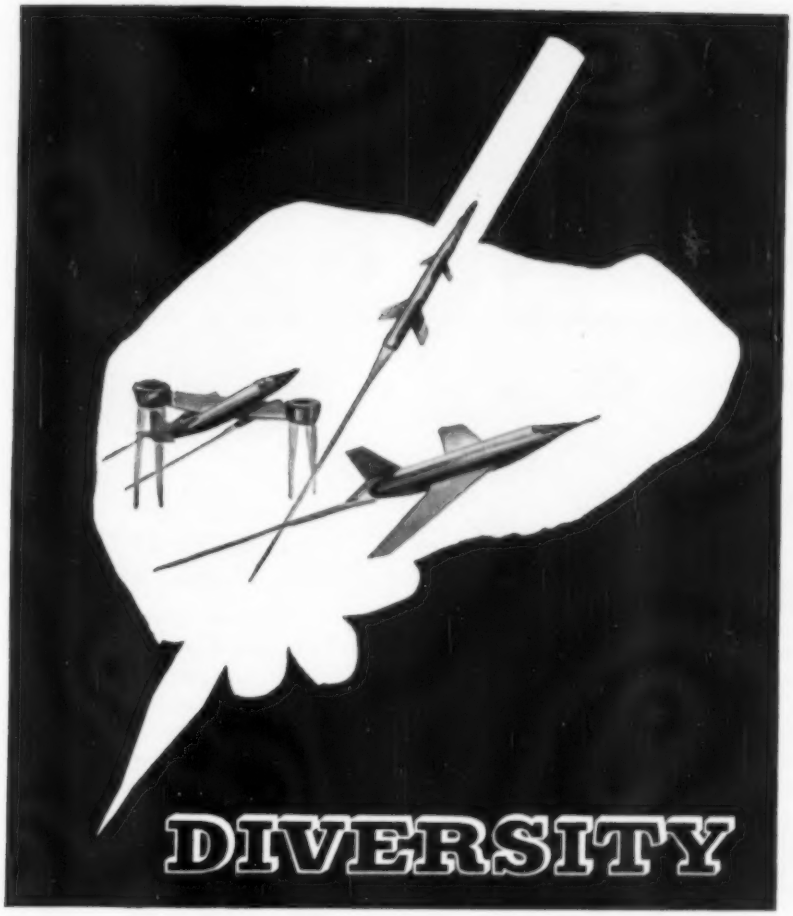

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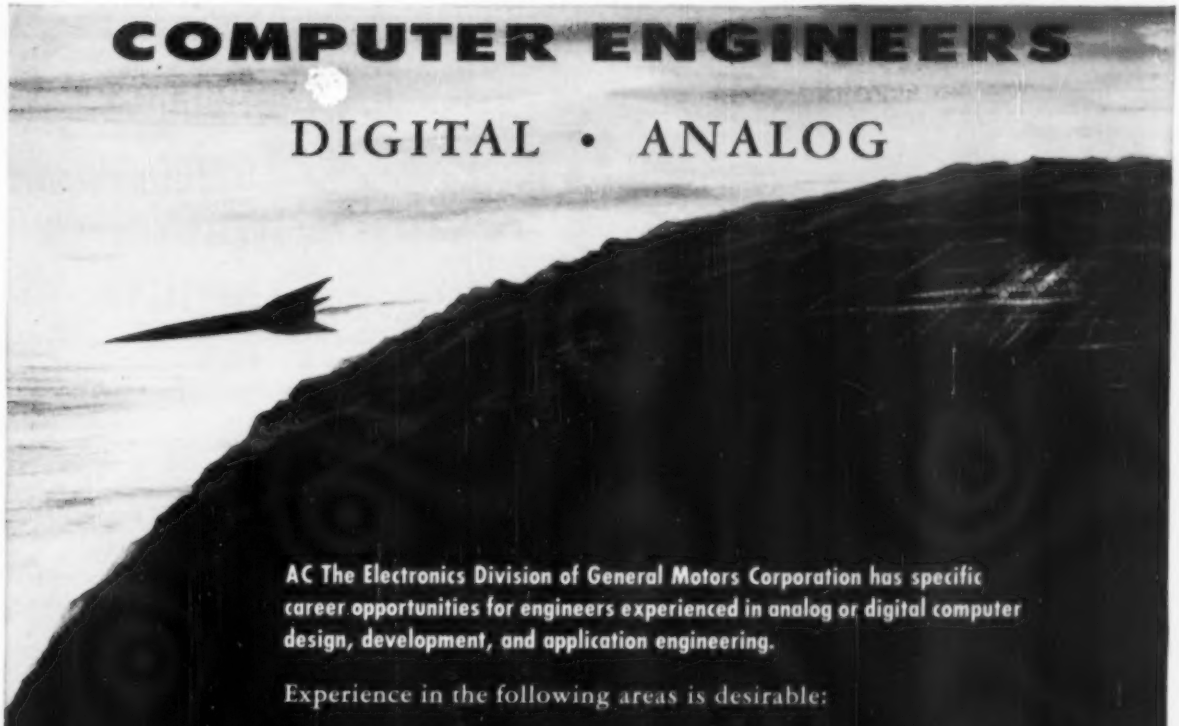

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Supervisor of Technical Employment

THE ELECTRONICS DIVISION
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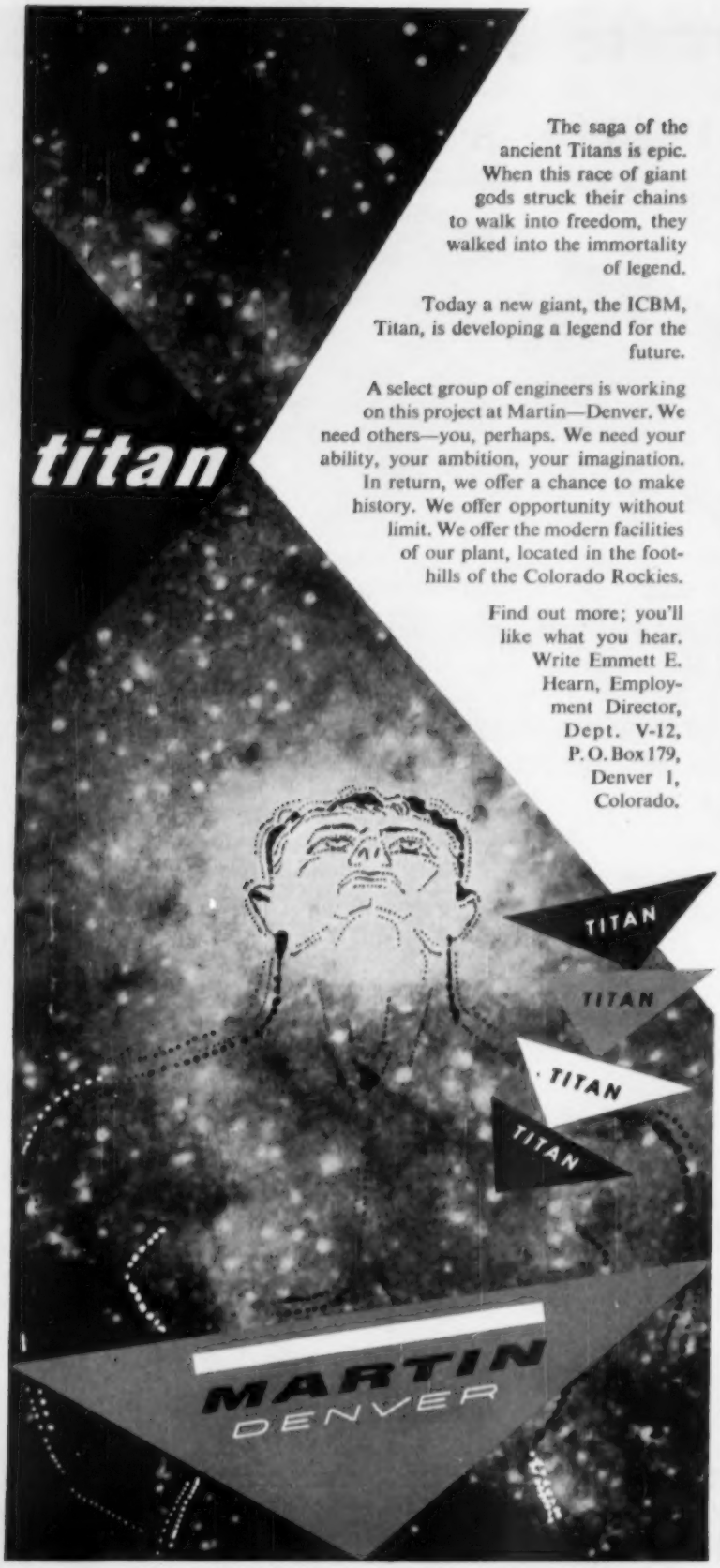

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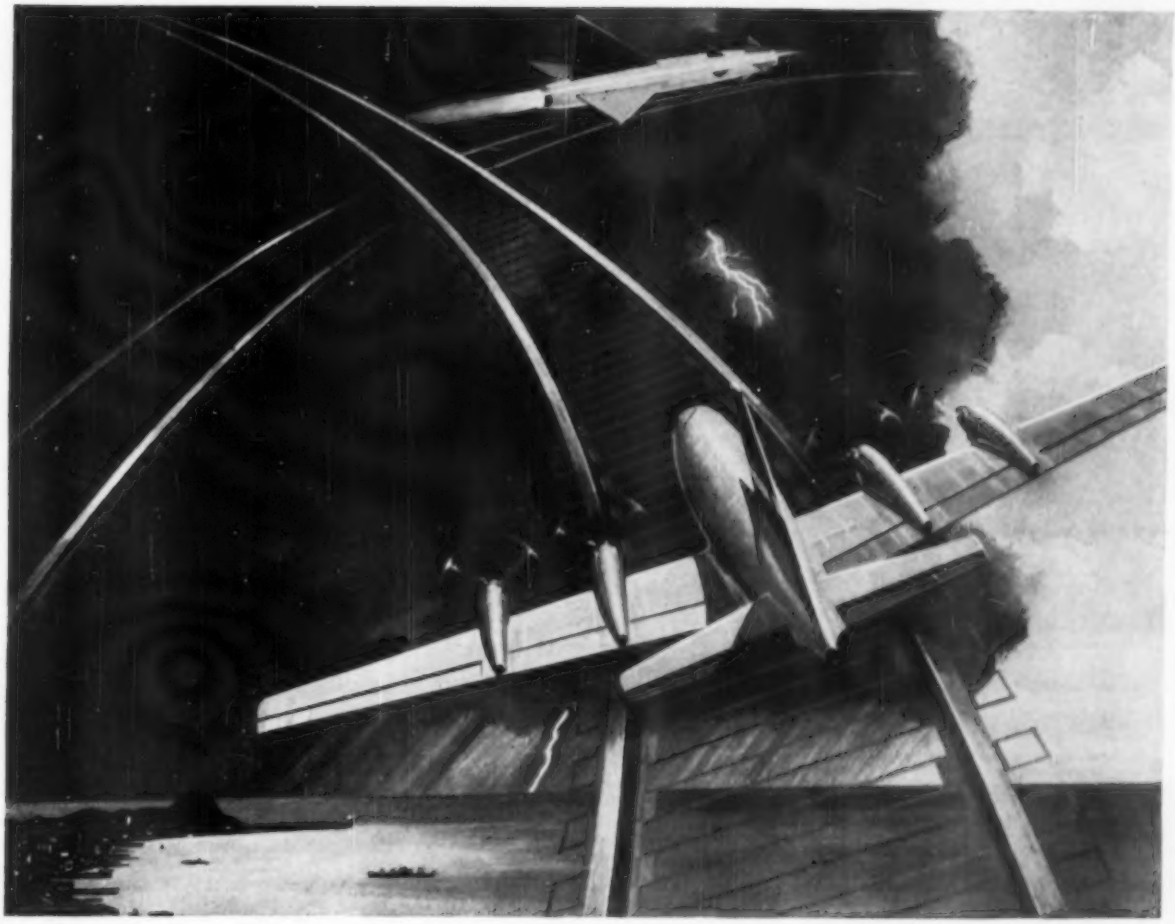

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Performs and assists in testing complex inertial equipment and in particular the inertial platform. Must be capable in directing the duties of test technicians and maintaining rigid production schedules. Must have experience in gyroscopic and basic gyroscopic test techniques.

TEST ENGINEER
Performs and assists in testing activities of complex computers for fire control and guidance systems. Must be capable of directing the duties of test technicians and maintaining rigid production schedules. Experience should include a background in basic test techniques in the above field.

OPERATIONAL EVALUATION ENGINEER
Conduct operational checks on electronic and electromechanical systems, locate and evaluate deficiencies and report on specific phases of the environmental test program.

DEVELOPMENT ENGINEER — CIRCUITRY
Research and development engineering work in radar pulse circuits, sweep and indicator circuits, intermediate frequency amplifier circuits, and feed back amplifiers. Must have post graduate experience in circuit development engineering with applications in both radar and countermeasures fields.

PRODUCT ENGINEER
Initiate, compile and maintain design standards on electrical, electronic and mechanical design subjects pertinent to fire control equipment and inertial guidance components. Must have considerable responsible experience on product design standards covering areas indicated in job studies.

PROJECT ENGINEER — AIRBORNE EQUIPMENT
Project engineering of computers, pro and anti submarine fire control equipment, airborne navigation plotting equipment and similar equipment. Preparation and proposals on equipment of such types.

RELIABILITY ENGINEER
Develop methods for evaluation of accuracy, reliability and operational suitability of missile guidance systems.

OPERATIONAL EVALUATION ENGINEER
Perform engineering studies and analysis of techniques for evaluating performance of missile guidance systems and its components including gyros, accelerometers, digital computers.

TEST SPECIFICATION AND PROCEDURES ENGINEER
Assess adequacy of test procedures, methods and test equipment in the major assemblies and complete fire control systems. Revise existing test procedures so that automated procedures and automated equipment may be utilized.

PROJECT ENGINEER — AIRBORNE EQUIPMENT
Guide and assist engineers in technical problems in field of electrical and electronic design, servo systems, missile guidance systems. Responsible for major product improvement program and test programs. Provide technical liaison with quality control. Heavy servo background desired.

GROUND EQUIPMENT ENGINEER
High degree of technical and administrative responsibility on complex projects involving the design and development of production test and field test equipment for gyroscopic systems and digital computers.

PRODUCTION TEST EQUIPMENT DESIGN ENGINEER
To administer and technically direct the design, development and manufacture of test equipment for production use in the manufacture, inspection and test of highly complex electronic equipment.

SYSTEMS EVALUATION (MISSILE GUIDANCE)
Perform functional engineering studies and design of inertial guidance systems, determine system and component requirements and performance, conduct system and component dynamic studies and simulation, perform error analysis.

GYRO DEVELOPMENT ENGINEER
Develop precision gyro systems including mechanical problems such as lubrication, temperature controls, hydrostatics, and vibration and electronic work on accelerometers, amplifiers, torquing circuits and electrical pickups.

PLATFORM ENGINEER
Conduct investigation of a theoretical nature relating to gyros or inertial platforms including design of closed loop control equipment pertaining to the above.

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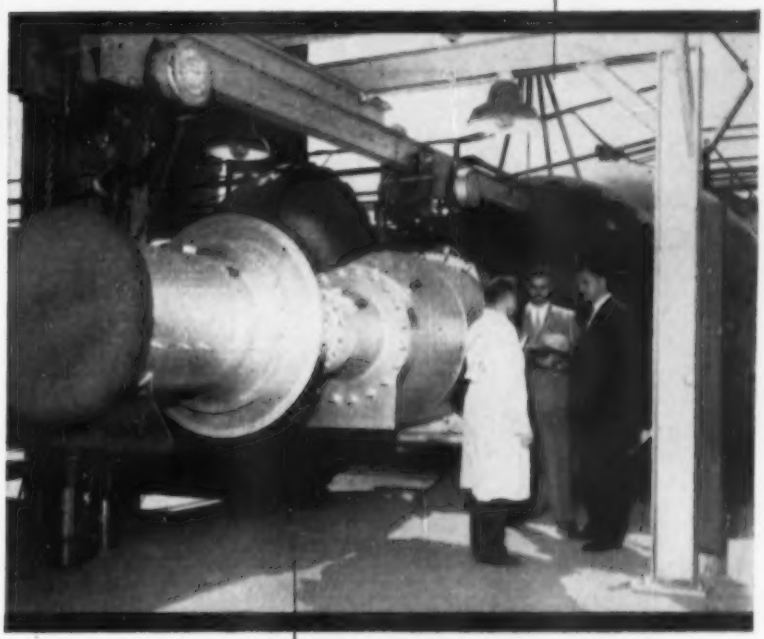
Test Engineers



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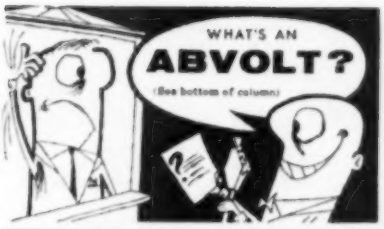

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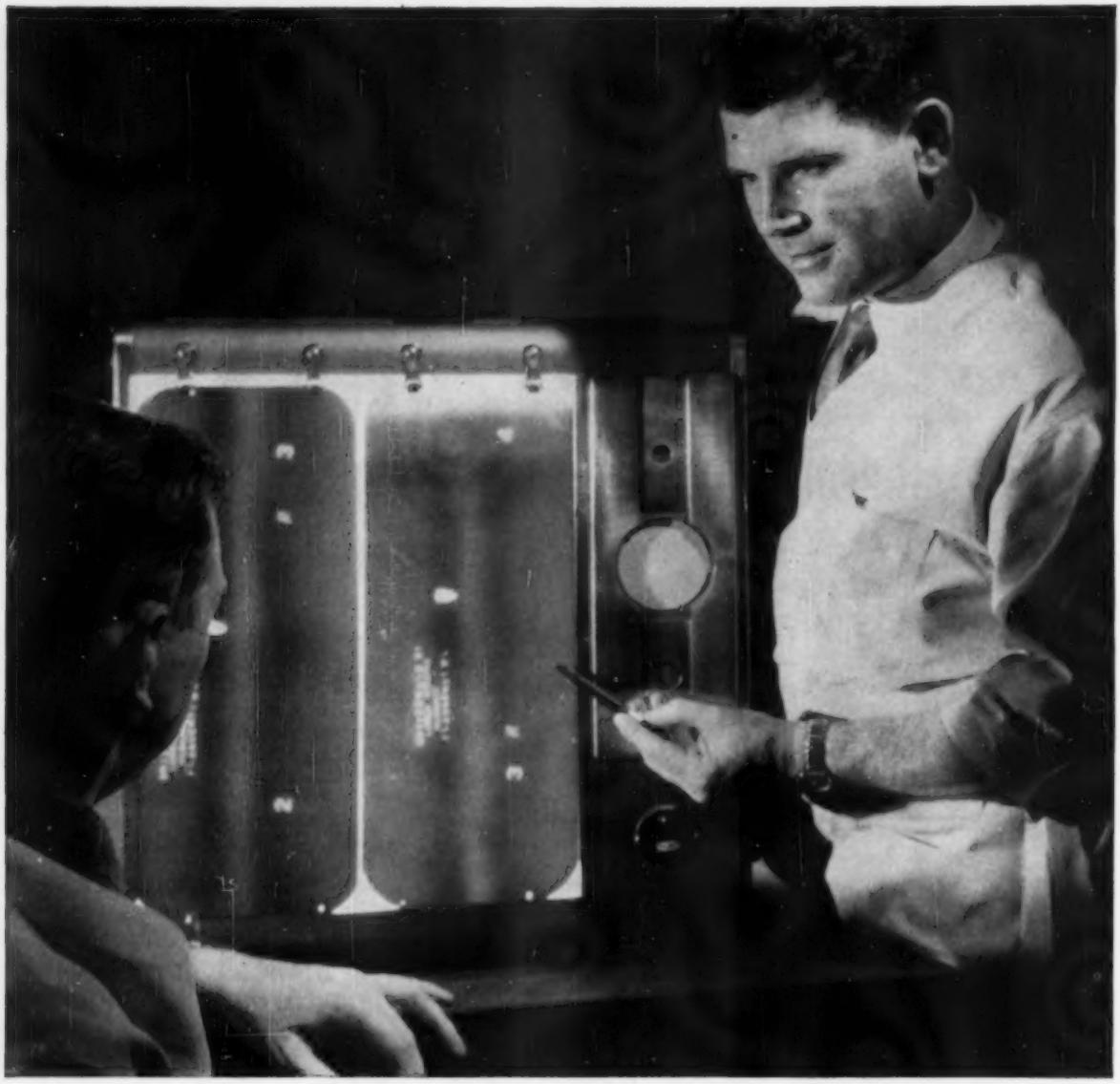

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LETTERS

Not that Noisy

We have seen the article on p. 41 of the April 22 issue of AVIATION WEEK ("Idlewild Will Admit Caravelle") discussing noise levels from the Boeing 707 aircraft. You are correct in stating that in AVIATION WEEK, Sept. 3, p. 50, BBN was quoted as having placed the Boeing 707 takeoff noise level at 130 db maximum overall sound pressure at 900 ft. Unfortunately, the distance stated in that article was incorrect so that the phrase should have read 130 db maximum overall sound pressure at 100 ft. If the level was measured at 1,000 ft. to the side of the unstick point during a full-power, four-engine takeoff, we would obtain a level of 100 db. The number 110 db at 1,000 ft. is for the final 707 and not the prototype. It assumes that the final 707 will have more powerful engines than the prototype, namely, JT3C-5 engines.

We think it is important that you bring to the attention of your readers this error in the original article.

LEO L. BERANEK, President
Bolt, Beranek and Newman, Inc.
Cambridge, Mass.

Surplus or Shortage?

After listening to a few intelligent arguments and several not very intelligent statements concerning the current pseudo aviation engineers shortage, I am prompted to get in the act. So:

A. What seem to be the facts?

1. Most of the aviation companies seem to hire college science graduates for largely non-engineering work while telling the men they are being hired for engineering work. This has a rapid fire result of disillusioning the troops and creating a company engineering morale problem. A situation of prostitution of the "pure" engineer by himself and the company results. (What is refreshingly surprising, though, about this sordid situation is that some of the universities and armed forces are aware of this situation and aren't very happy with it.)
2. The average aviation engineer's job could be held down very easily by an average sharp male high school student majoring in the sciences. (This fact is well known, even to the men in the shop.)
3. The average aircraft company is bogged down by red tape empires, both engineering and non-engineering, created by Madison Avenue type knuckleheads in the individual companies and in the armed forces; this necessitates too much non-productive paper work for the engineers and slows down their creative work, and thus helps create a false shortage of engineers.
4. The general mass of "thinking" engineers in the industry feel there is really a surplus of engineers rather than a shortage. Further, they feel like they are stagnating technically. (This has an additional deleterious effect on their work output which also helps create the false shortage.)

Aviation Week welcomes the opinion of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42 St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

B. What are the solutions?

For 1 and 2:

1. Hire male high school students and train them as needed. You get more and better work from undertrained men who are trying than from overtrained disillusioned men. (We have too many people going to college now—English majors, lawyers, time study majors, etc. —for snob appeal and/or fear of an honest days work with their hands without bringing the sciences into this predicament.)
2. Let engineers hire engineering people. The average personnel man is usually some 8-ball ex-engineer or some Madison Avenue character who couldn't tell a good scientist or engineer if he stepped on one. (A few good engineers are all that is needed really. And let us not confuse supervision with creative engineering.)

For 3:

1. Turn the project engineers loose with real authority and control of the project purse strings. If he "boo-boos," sack him and his crew. If he makes it, give him a real piece of pie. Let the armed forces determine the worth of the product in the field, since they really own the industry anyway. If it fails, cancel contracts on the spot and sack the project engineer. We must all recognize that aviation is not a public utility but a boom or bust deal. This type of operation would chop off paper shufflers, lawyers, personnel people, and other non-producers—their pay could be distributed among the engineers.)

For 4:

1. Knock off this asinine 8-5 concept and let the men create and work toward a target date as they see fit. If the job takes 15 hours a day, 7 days a week, fine; if the job is finished early then everybody goes skiing for a couple of weeks. This will allow the individual engineer to feel that he is contributing and not a part of a faceless surplus mass of people. A desk, a charcoal colored suit, a vapid smile, a bow tie, and 8-5 hours don't necessarily mean creative engineering. We need less teamwork and toothy grins and more solid scientific thinking. And where in the world the idea got started that engineering is a gentlemen's profession is difficult for me to fathom—probably the same line of reasoning that it takes a gentleman to be an officer in the services. One summer's work in the industry would change the most obtuse and/or starry-eyed.
2. Give each engineer an individual room with a blackboard. You have to isolate most people to start solid scientific thinking. (This step alone would show how really few engineers are needed and create a 1949 type of engineers surplus overnight.)
3. Constantly train all technical people in the sciences. When one is learning one doesn't stagnate. Every engineer needs to take at least one daytime university science course each semester merely to keep abreast of his particular specialty. Please, no culture.

And as an aside, let's not be afraid to have some honest complaining. We are *all* so busy "getting along" and being part of a "team" we are losing the war with Russia, and we are at war, regardless of the administration and State Department statements. I think perhaps we are being taught to lose sight of a basic psychological fact that a person does not have to like a person to work well with that person—all that is needed is a healthy respect for the other person's abilities and professional integrity. Progress is made by effort and that always calls for some hassle. (There also seems to be a determined effort to make "Don't Rock the Boat" our national anthem.)

A (HAPPY) JOBSHOPPER

"Best" On ABMA

On behalf of this command, I want to extend my thanks to you and Dave Anderton for his excellent article "Hand-Picked Team Develops Jupiter" which was published in your April 15 issue (p. 50). It was the best piece of its kind which has appeared since the Agency's activation 1 February 1956.

May we have your permission to reprint the piece for distribution to our people?

GORDON L. HARRIS
Public Information Officer
U. S. Army Ordnance Corps
Army Ballistic Missile Agency
Huntsville, Ala.

Not GM Division

Under the subheading "Boeing" on p. 41 of the April 15 issue of AVIATION WEEK, in the article entitled "Manufacturers Push to Meet Jet Deadlines," you mention our company as being a division of General Motors.

This is in error. We have no connection with General Motors, nor have we ever been connected with them.

Our division is a division of the Twin Coach Company, Kent, Ohio.

G. H. HECHT, VICE PRESIDENT
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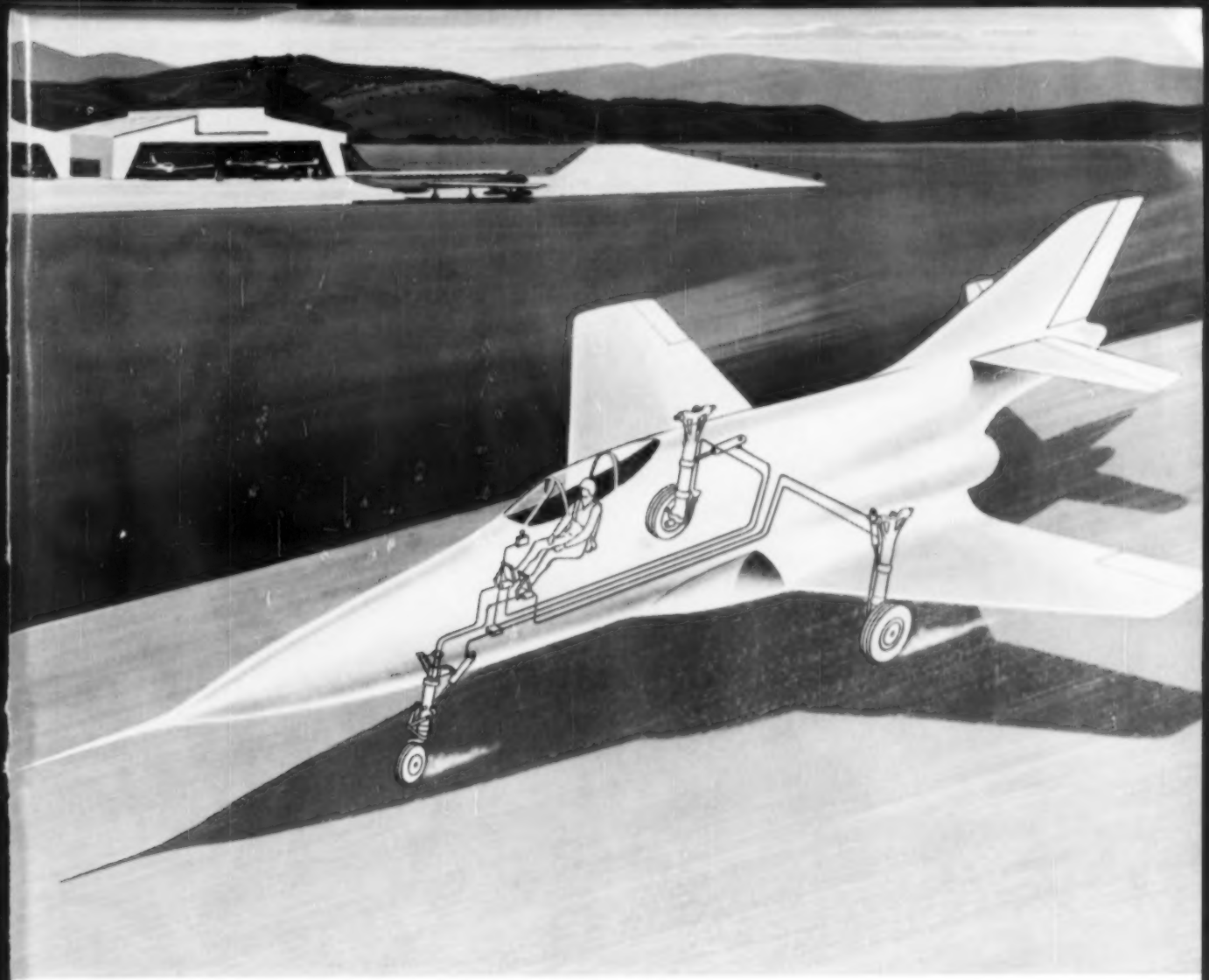

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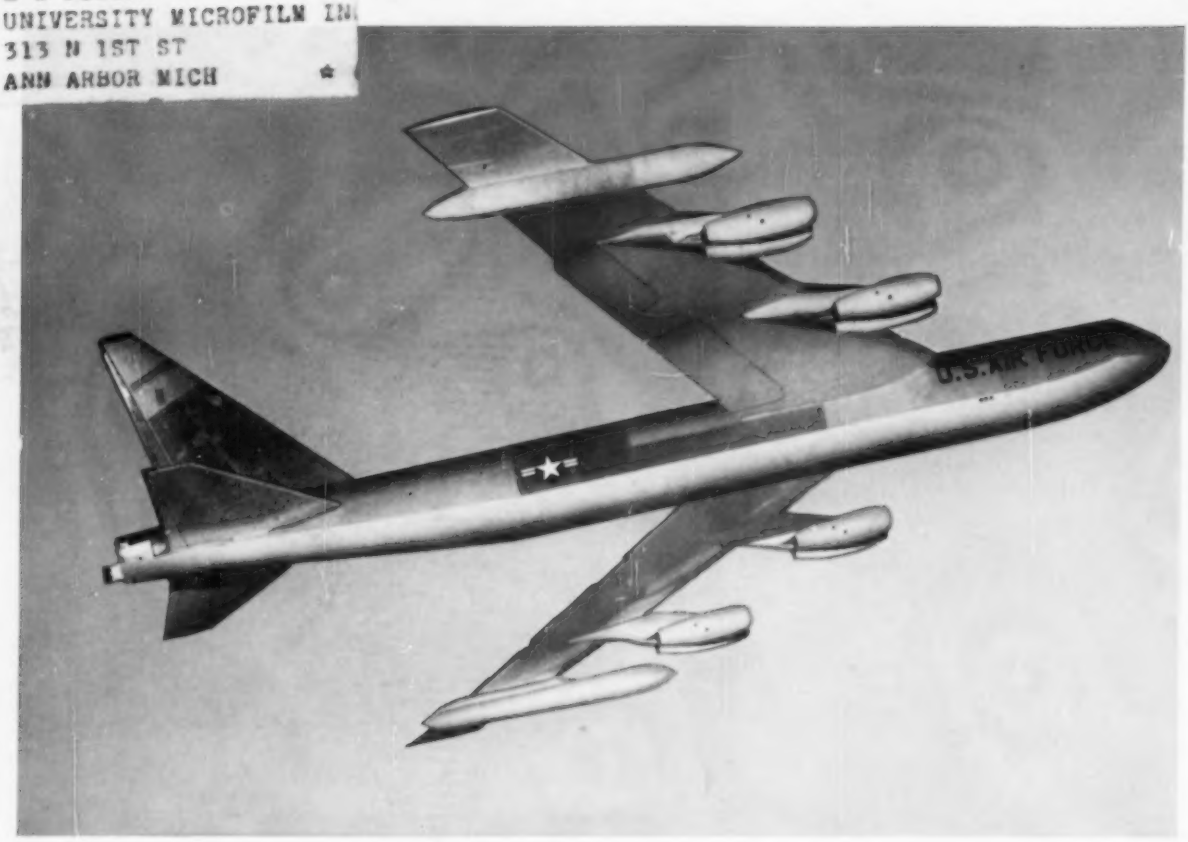

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